FAR EASTERN REPRESENTATIVES AT THE INTERNATIONAL BOTANICAL CONGRESS[1]

A great gathering of botanists and other plant technologists occurred this year at Cornell University, Ithaca, New York. There was a goodly representation of men who had seen service in the Philippines and Malaysia. We are very glad indeed to make of permanent record a picture of this group, all the members of which have played important parts in the development of Philippine and Far Eastern work. We greatly regret that the picture does not also include Doctor Copeland, Dr. Wm. H. Weston, and Prof. D. A. Herbert, all of whom should have been present in order to complete this notable group. Though Doctor Copeland is represented by his son, Herbert, now also a botanist and whom we remember as a boy at Los Baños. Very appropriately appearing in this group are four College of Agriculture Filipino candidates for higher degrees, now at Cornell. These are Juan Rodriguez, Julian Agati, Alexander Gordon, and Felipe Adriano.

Dr. Forman T. McLean was appointed Instructor in Plant Physiology at the College of Agriculture in 1915, becoming a full Professor in 1920. He resigned in 1921, and is now research physiologist at the Rhode Island Agricultural Experiment Station.

Dr. C. D. de la Rue and Dr. R. D. Rands are both from service in Netherlands Indies (Java and Sumatra). Doctor La Rue is now at University of Michigan and Doctor Rands is connected with the United States Department of Agriculture.

Dr. F. C. Gates headed the botanical work in the College of Agriculture from 1912 to 1915 and is now at the Kansas Agricultural College.

Herbert Copeland whom we remember as a fast-growing boy at Los Baños, has now reached man's estate, sports a mustache, and is following faithfully in his eminent father's footsteps. He has lately been teaching botany in the Sacramento High School and will soon enter upon his Ph. D. candidacy in University of California, Berkeley.

Prof. F. P. McWhorter was appointed at College of Agriculture in 1921 and resigned in 1923. Although his period of service was short he had the distinction of having been acting head of two college departments, first that of Plant Physiology, and later that of Plant Pathology. He is now plant pathologist at the Virginia Truck Experiment Station.

Dr. Sam F. Trelease came to the College of Agriculture in 1917 as head of Botany work. He resigned in 1920. While in the College he was for

[1] General contribution from the College of Agriculture No. 177.

two years editor of THE PHILIPPINE AGRICULTURIST, doing much to improve the style and form of this journal. He now holds a professorship in botany in Columbia University, New York City.

Dr. Wm. H. Brown is the well-known director of the Bureau of Science in Manila.

Two of the Filipinos, Mr. Juan de G. Rodriguez, a former preparatory student in the College, and Mr. Julian A. Agati, B. S. Agr. '23, are in America on their private resources; the latter coming from our department of Plant Pathology. Mr. Alexander Gordon, B. S. Agr. '24, went from the Department of Agricultural Engineering as a pensionado of the Governor General's Office. Mr. Felipe T. Adriano, B. Agr. '19, (later, M. S. Univ. Wis.), was an analyst in the Department of Chemistry in 1925 when he received his foreign fellowship.

The epic story of the development of the College of Agriculture of the Philippines is not the story of any one man. From the beginning, back in 1910, when this great project was undertaken by that splendid pioneer, eminent botanist, and efficient teacher, Doctor Copeland, and very few helpers, down to the present day of an extensive physical plant and large faculty and student body, the building has been accomplished by the effective efforts of many able hands. Each, in passing, left his mark. The extraordinary challenge here, not only to build a great College, but to build complete courses in all lines, from local materials and adapted to local conditions and needs brought out the best from all who came in contact with it. There never has been a teacher connected with this College in the technical lines but was also an active producer. And this is characteristic of the College of today.

So that it may justly be said of all members of the group presented as our frontispiece that the progress of Oriental science and Oriental peoples was distinctly advanced through their efforts. Applying a good Far Eastern expression—they were "can-domen"!

CHARLES FULLER BAKER
Dean, College of Agriculture.

Whoever thinks that a working day of eight hours will be sufficient for him to attain his purpose, let him desist from the study of the exact sciences and choose a sphere of activity in which the number of working hours is regulated by law.—ERNEST COHEN.

FACTORS INFLUENCING PERIODICITY IN THE ABUNDANCE OF CERTAIN FORMS OF TERRESTRIAL INSECT LIFE IN THE PHILIPPINES[1]

LEOPOLDO B. UICHANCO
Of the Department of Entomology

Economic entomology is essentially applied ecology. This fact was first pointed out by Forbes (1895). The recognition of this aspect of the question changes our viewpoint in attacking problems relative to insect control.

In the torrid zone, as well as in the temperate, insects vary in their degree of destructiveness and amenability to control, depending on the collective influence of the sum of local environmental factors which operate on them. Many of these factors are a part of the normal natural forces, some of them being capable of being modified, though often very slightly, by man; but a large proportion is almost entirely beyond his control.

In temperate regions, where there is a definite winter, climate plays a very considerable direct part in determining seasonal abundance of insects in active stages. The freezing temperature for four or five months is unfavorable for most forms of animal, and even plant, life. Animals usually tide over the winter by passing through a dormant stage. Insects, with the exception of one or two species which normally live in snow, are usually in the egg or pupal stages, or in some other latent condition throughout all the winter months. Only about one half of the year, more or less, offers conditions favoring their active life, so that all the functions of feeding, reproduction, dispersal of species, and other related phenomena are crowded into this reduced space of time. Such is the influence of climate as a controlling factor in those regions that many of the insect species, the normal habitat of which is in the open produce only one generation a year.

In the tropics, where the Philippine Islands are located, insects are not subject to drastic climatic changes. In many regions of the Archipelago, rainfall, which is the most important element in determining the nature of a tropical climate, is fairly evenly distributed throughout the year. Even in the so-called dry months, there is occasional rainfall (Coronas, 1920). Low extremes of temperature are unknown, except rarely in very high altitudes. Conditions, therefore, are in general favorable for almost uninterrupted maintenance of the insects' active life throughout the year.

[1]Read before the Philippine Society of Technical Agriculturists, Los Baños Meeting, September 26, 1926. Contribution from the Experiment Station, College of Agriculture, University of the Philippines, No. 400. Received for publication September 29, 1926.

However, in spite of the equable climatic conditions, there are only certain favorable months for collecting insects in the Philippines because they are relatively more abundant then, and scarce at other times. In Los Baños and vicinity, for instance, general insect collecting is much more profitable through May, June, and July and through November, December, and January than at other months. Likewise, farmers know from experience that where they can raise two crops a year of a certain plant in a given locality, the crop is bound to be more heavily damaged by pests at one season than at another. In the case of rice, for instance, the planters in Calamba and other nearby towns where field irrigation is practiced, the rainy-season planting, which reaches the "milk" stage in about November or December, suffers more from the attack of the rice bug, *Leptocorisa acuta* Thunberg, than the dry-season planting (Uichanco, 1920). The sugar cane bud moth and stem borer, *Laspeyresia schistaceana* Sn., is more destructive during the rainy than the dry season.

A discussion of some of the more important factors which apparently determine abundance or scarcity of insects at certain seasons in the Philippines is given below:

Food. In a recent paper by Weiss (1925), he shows that about one half or over of the insect species are phytophagous (plant-eaters). According to the results of his survey, this condition obtains in the tropics, as well as in temperate regions. The food supply of these insects in the tropics is largely influenced by the annual distribution of rainfall, since during the months when there is limited or no precipitation, plants undergo a period of rest, although in most cases this habit is not quite as marked as in the approach of winter in temperate climates. Plant-feeding insects, especially those that depend for their food on young foliage, correspondingly suffer from lack of adequate food supply. Many individuals perish in the dry season, evidently not from the effect of high temperature, since they can easily get access to cooler spots, but more as a result of starvation. The more successful ones succeed in passing temporarily into a dormant state at or before the onset of this unfavorable period.[2] Insects which are not phytophagous are remotely affected by the scarcity of suitable plant food, since practically all of them, especially the parasites and predators, are dependent, directly or indirectly, for food on insects or other animals which feed on plants or on plant products.

[2] Members of certain groups of insects, however, apparently exhibit considerable flexibility in their adaptation; they seem to remain unaffected by any of the normal fluctuations in a tropical environment. Aphids, for instance, express their response to untoward winter conditions in temperate climates in the production of amphigonous forms, which lay eggs. In the tropics, on the other hand, they maintain, in all the species known so far, an uninterrupted series of parthenogenetic, viviparous generations throughout the year. Parthenogenesis and the accompanying viviparity in aphids occur so long as environmental conditions are favorable for these insects' vital activities.

After this period of rest, most of the plants produce flowers, at the beginning of the rainy season. Flower-inhabiting insects, like most thrips, and those that feed on nectar, correspondingly begin to increase at this time.

Natural enemies. Parasitic and predaceous insects and other animals, particularly birds, and fungous and bacterial diseases play a larger part in keeping down the number of insects than is generally appreciated in this country.

Parasites exhibit a certain degree of specificity in their host relations, so that an entomophagous insect, fungus, or bacterium is usually confined to one particular host species. Where a parasite has several hosts, the latter, as a rule, belong to closely related phylogenetic groups. The increase in the number of phytophagous insects during the more favorable rainy months brings about, in direct proportion, a corresponding increase in the number of their natural enemies. Woodworth (1922), on the basis of this observation on *Coccus viridis* Green on various species of Citrus, concludes that,

> the period of effectiveness of parasitic fungi is only during the rainy season, the fungi appearing on new scales and becoming effective [in Los Baños] from August to November and then falling off in numbers, until in March few recently parasitized scales are to be found. * * * Parasitic insects are undoubtedly a large factor in the seasonal cycle of *Coccus viridis* and other coccids on Citrus here, but the maximum effectiveness is not apparent until well along into the rainy season after the harm by the scales has already been accomplished. The highest per cent of parasitism were recorded in July, August, September, and October, while the period of maximum scale abundance and injury occurred in March, April, May, and June.

In the case of *Spodoptera mauritia* Boisd., parasites, especially a species of Chelonus, are plentiful in July and August, and are frequently met with as eggs or larvæ in the bodies of fullgrown caterpillars. Toward the end of the rainy season, the Spodoptera becomes very scarce; and practically none can be found at the beginning of the dry season.

The abundance of *Laspeyresia schistaceana* during the rainy season is followed by a corresponding increase in the eggs and larvæ of a tachinid parasite which lives in them. So nearly thorough is the work of the tachinid larvæ during the rainy season, that exceedingly few of the adult moths succeed in emerging. Hence Laspeyresia infestation is very light during the earlier and middle parts of the dry season. Tachinid flies which have emerged from the parasitized larvæ are very abundant notably around February and March, but on account of the scarcity of suitable host material then, very few of them succeed in ovipositing. The result is that the parasites decrease numerically. Under these more favorable conditions, Laspeyresia, on the other hand, begins to regain its lost numerical strength for the rainy season following.

Direct effect of climate. The abundance or scarcity of suitable host plants as a result of varying degrees of precipitation throughout the year, and the consequent bearing on insect life, may be considered an indirect effect of climate. On certain groups of insects, however, which are more or less sedentary in their habits, such as aphids on leaves, branches, stems, buds, flowers, or fruits of plants, climate plays a direct part. Torrential rains, which are so characteristic of the tropics, wash away and kill many of the individuals, and specimens of these groups are hard to secure during months of heavy precipitation. Many of the sedentary insect forms, other than eggs and pupæ, have sufficient natural protection in the form of waxy coating, covering of silk or hair, galls, etc., so that direct, mechanical untoward effect of heat during the dry months seems far from likely.

DISCUSSION AND CORRELATION

The determination of the actual causes of periodicity is a very elusive problem, involving, as it does, one of the results of the reaction of the organism with the complex of interrelated and overlapping variable factors in its environment. At best, the relative values placed on the more conspicuous factors enumerated above are but rough estimates. Moreover, the fact should be borne in mind that any of these imputed causes acting singly and deprived of its normal alliance with the rest of the natural ecological forces, if such a process were feasible, would perhaps fail to produce the phenomenon of periodicity in insect abundance. Likewise, the following statement from Cook (1924) is significant in connection with this question: "The insect fauna of a given region is not a single stable unit, varying only in abundance from year to year, but is a composite of smaller groups, each of which has more or less definite optimum. The composition of the fauna in a given season is very definitely related to the climatic conditions prevailing at the time of growth."

Climate itself is a composite of many variables. According to Ward (1918), it "is the resultant of the average atmospheric conditions, or, more simply, it is the average condition of the atmosphere. Weather is a single occurrence, or event, in the series of conditions which make up the climate. The climate of a place is in a sense its average weather." The same author further gives an illuminating discussion of the characteristics of a tropical climate. He points out that the dominant aspects of the tropical belt,

> embracing but a little less than one-half of the earth's surface, is the remarkable simplicity and uniformity of its climatic features. This simplicity is reflected in the striking regularity in the recurrence of the ordinary weather phenomena. The tropics lack the proverbial uncertainty and changeableness which characterize the weather of the higher latitudes. In the torrid zone, weather and climate are essentially synonymous terms. Periodic phenomena, depending upon the daily and annual march of the sun, are dominant. Non-periodic weather changes are wholly subordinate. * * * In a true tropical climate seasons, in the temperate zone sense, do not exist. The variations in temperature throughout the year are so slight that the seasons are not classified

according to temperature, but depend on rainfall and the prevailing winds. The life of animals and plants in the tropics, and of man himself, is regulated very largely, in some cases almost wholly, by rainfall.

In the Philippines, two principal observable immediate factors in the environment apparently determine periodic fluctuation in the number of insects: (1) Condition of food plant, as influenced by periodic abundance or scarcity of rainfall[3]. (2) Natural enemies, which with their hosts hold a delicately sensitive balance that tilts alternately to either side of the scale. At times the scarcity of insects may be only apparent, when they pass through dormant stages, which often occur under inaccessible or otherwise not readily observable conditions; but more frequently insects are actually reduced in number, on account of the fact that some or many of the individuals are too slow in adapting themselves to the changes following the advent of the dry period and consequently die, or that the natural enemies either kill them or sap their vitality to the extent of inhibiting reproductive functions. The effect of tropical climate is largely indirect. The dry months reduce the quantity and in most cases modify the quality of available food plants, with the attendant chain of consequences on insect life.

The temporary scarcity of phytophagous insects during a part of the more favorable rainy months is probably mainly due to the work of natural enemies, which, on account of the abundance of the former following the first weeks of rain, have multiplied correspondingly. The number of the phytophagous insects is then regained toward the end of the rainy season, until the natural enemies begin again to be on the ascendency.

As to the parasitic and predaceous insects, their abundance is necessarily in direct proportion to their available food. There is this additional peculiarity about parasitic insects, however: with the exception of the order Strepsiptera, all the females of which are sedentarily parasitic throughout their entire lives, practically all the others, so far as known, are free living in the adult stage. The abundance of adults of many parasitic species, therefore, far into the middle of the dry season, when phytophagous insects are scanty, is not an anomaly. They represent a continuation of the life history of the parasites which begin their work late in the rainy season.

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[3] "In the tropics, where there is no hibernation [among insects], æstivation occurs over the dry season. Though æstivation is associated mainly with heat, relative humidity is also a factor." (Folsom, 1922, p. 366.)

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CALIBRATION OF THE BAUSCH AND LOMB SACCHARIMETER OF THE UNIVERSITY OF THE PHILIPPINES SUGAR MILL[1]

V. G. LAVA AND J. A. RIVERA
Of the Department of Agricultural Chemistry

WITH ONE GRAPH

A Bausch and Lomb saccharimeter which was manufactured for use at 27.5°C. has been calibrated in this laboratory at the same temperature, with the use of pure sucrose.

DESCRIPTION OF THE SACCHARIMETER

The saccharimeter was bought from Braun-Knecht-Heimann Co. The polarizer is of the Lippich type, and is made of two nicol prisms, the larger one being of the Glan-Thompson type and the smaller one a prism placed in front of the larger and covering one half of the field. The analyzer is a Glan-Thompson prism. The quartz compensation is of the single wedge type which consists of a long movable wedge, a short stationary wedge and a stationary plate, all of quartz and mounted in a dust-proof case. The movable quartz wedge is mounted together with the scale plate on a fitted slide which is driven by means of a rack and pinion. The scale and vernier are engraved on closely adjacent glass plates, so that the troublesome black dividing line so common in other saccharimeters is eliminated. Illumination of the saccharimeter is provided by means of a 100-watt mazda lamp, placed in a lamp house with an opening on one side, over which is a plate of ground glass. A reddish yellow glass filter is placed between the light source and the polarizer, to take the place of the potassium bichromate solution.

THE CONSTANT TEMPERATURE ROOM

All polarizations were made in a constant temperature room. The dimensions of the room are 2.5 m × 2 m. × 5 m. The outside wall is of hollow wood and is insulated with saw dust. The temperature was regulated by

[1] This article is an abstract of the thesis presented by the junior author for graduation, 1926, from the College of Agriculture with the Degree of Bachelor of Science in Agriculture (Sugar Technology Curriculum), No. 236; Experiment Station contribution No. 401. Prepared in the Department of Agricultural Chemistry. Received for publication, September 3, 1926.

means of an electric fan in conjunction with ice outside of the room, and an electric heater inside the room. The heater consisted of nichrome wires wound upon an insulated frame placed at the center of the room and directly opposite the direction of the air from the fan. The flow of electric current was controlled by means of a mercury contact actuated by a change in volume with temperature of kerosene contained in a glass tube about a meter long and 1.5 centimeters in diameter. Control of the temperature is effected in the following manner: The fan is started, and this forces air over the ice into the room. As soon as the temperature goes below that for which the thermostat was set (27.5°C.) the contracting kerosene causes the mercury contact to be opened, so that the current that passes through a relay is stopped, and thus a heavy electric current is allowed to pass through the nichrome wires.

PREPARATION OF THE PURE SUCROSE

The sucrose was prepared according to the method adopted by the International Committee (Stratton, 1918). Two samples were prepared and used. Their percentage of purity, according to chemical and polarimetric analyses is shown in table 1.

TABLE 1

Sample of sucrose	*Purity by chemical analysis per cent*	*Purity by the specific rotation method per cent*	*Difference between the two methods per cent*
A	99.84	99.83	0.01
B	99.87	99.86	0.01

METHOD USED

For the verification of the scale readings of the saccharimeter, the Scheibler's method of hundred polarization (1912) (Method I) and the method of Browne (1912) of taking fractions of the normal weight for each degree point of the scale (Method II), were adopted, thirty readings of each method being made for each division calibrated.

RESULTS

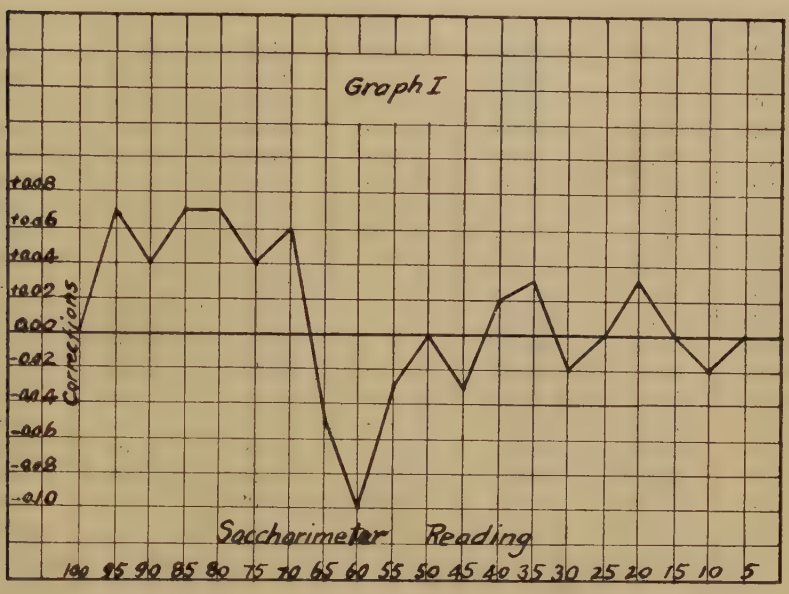
Table 2 contains the average corrections to the scale by the use of the two samples of sucrose. It is evident that these corrections do not differ by more than 0.04°, the average difference being 0.028°.

Table 3 contains the average corrections to the scale by the use of the two methods. A comparison between the methods of verification of the

scale reading shows that their maximum variation is 0.04°, the average variation being 0.025°.

Table 4 contains the final average corrections to be applied to the scale and their corresponding probable error of the mean.

The chart shows the results of table 4 in graphical form.



CONCLUSION

The maximum corrections of +0.07° and —0.10° would seem to indicate that the saccharimeter tested does not fulfill the requirements of the American Sugar Chemists (Anonymous, 1920) and (Browne, 1920), 0.05° being the maximum allowable correction. However, the instrument may be used accurately, provided these corrections are taken into consideration.

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TABLE 2

Corrections to be made for the saccharimeter using samples A and B, irrespective of methods

SCALE DIVISIONS	SAMPLE A METHODS I & II	MEAN CORRECTION FOR 30 TRIALS		SAMPLE B METHODS I & II	MEAN CORRECTION FOR 30 TRIALS	
	Mean average for 30 trials	+	—	Mean average for 30 trials	+	—
100.00	100.00	——	——	100.00	——	——
95.00	94.92	0.08	——	94.94	0.06	——
90.00	89.95	0.05	——	89.96	0.04	——
85.00	84.91	0.09	——	84.94	0.06	——
80.00	79.91	0.09	——	79.95	0.05	——
75.00	74.95	0.05	——	74.96	0.04	——
70.00	69.94	0.06	——	69.94	0.06	——
65.00	65.05	——	0.05	65.05	——	0.05
60.00	60.10	——	0.10	60.10	——	0.10
55.00	55.05	——	0.05	55.01	——	0.01
50.00	50.00	——	——	50.00	——	——
45.00	45.04	——	0.04	45.02	——	0.02
40.00	39.98	0.02	——	39.98	0.02	——
35.00	34.98	0.02	——	34.96	0.04	——
30.00	30.03	——	0.03	30.00	——	——
25.00	25.00	——	——	25.00	——	——
20.00	19.97	0.03	——	19.96	0.04	——
15.00	15.00	——	——	14.99	0.01	——
10.00	10.02	——	0.02	10.01	——	0.01
5.00	4.99	0.01	——	5.00	——	——

TABLE 3

Corrections to be made for the saccharimeter using methods I and II, irrespective of samples

SCALE DIVISIONS	SAMPLES A & B METHOD I	MEAN CORRECTION FOR 30 TRIALS		SAMPLES A & B METHOD II	MEAN CORRECTION FOR 30 TRIALS	
	Mean average for 30 trials	+	—	Mean average for 30 trials	+	—
100.00	100.00	——	——	100.00	——	——
95.00	94.93	0.07	——	94.92	0.08	——
90.00	89.96	0.04	——	89.95	0.05	——
85.00	84.93	0.07	——	84.92	0.08	——
80.00	79.94	0.06	——	79.92	0.08	——
75.00	74.96	0.04	——	74.96	0.04	——
70.00	69.95	0.05	——	69.93	0.07	——
65.00	65.03	——	0.03	65.07	——	0.07
60.00	60.09	——	0.09	60.11	——	0.11
55.00	55.02	——	0.02	55.04	——	0.04
50.00	50.00	——	——	50.00	——	——
45.00	45.02	——	0.02	45.05	——	0.05
40.00	39.98	0.02	——	39.98	0.02	——
35.00	34.98	0.02	——	34.97	0.03	——
30.00	35.01	——	0.01	30.03	——	0.03
25.00	25.00	——	——	24.99	0.01	——
20.00	19.97	0.03	——	19.96	0.04	——
15.00	14.99	0.01	——	14.99	0.01	——
10.00	10.01	——	0.01	10.02	——	0.02
5.00	5.00	——	——	4.99	0.01	——

TABLE 4

Final correction for the Bausch and Lomb Saccharimeter

SCALE DIVISIONS	MEAN AVERAGE FOR 60 TRIALS	PROBABLE ERROR OF THE MEAN	COBRECTION FOR 60 TRIALS	
			+	—
100	100.00	±0.000	——	——
95	94.93	±0.004	0.07	——
90	89.96	±0.005	0.04	——
85	84.93	±0.004	0.07	——
80	79.93	±0.004	0.07	——
75	74.96	±0.003	0.04	——
70	69.94	±0.004	0.06	——
65	65.05	±0.005	——	0.05
60	60.10	±0.006	——	0.10
55	55.03	±0.005	——	0.03
50	50.00	±0.0002	——	——
45	45.03	±0.004	——	0.03
40	39.98	±0.004	0.02	——
35	34.97	±0.005	0.03	——
30	30.02	±0.004	——	0.02
25	25.00	±0.003	——	——
20	19.97	±0.004	0.03	——
15	15.00	±0.003	——	——
10	10.02	±0.003	——	0.02
5	5.00	±0.006	——	——

A PRELIMINARY STUDY OF THE DAIRY QUALITIES OF GOATS[1]

VALENTE VILLEGAS AND ALFREDO D. PABLO
Of the Department of Animal Husbandry

WITH TWO TEXT FIGURES

The doe is referred to often as the "poor man's cow". Basing computation on live weight, her capacity for milk production is, in fact, much greater than that of the cow. If goats in the Philippines were used for milking purposes up to their possibilities, a good supply of a most wholesome and nutritious food, goat's milk, would be provided. A food that is now very little used.

REVIEW OF LITERATURE

Thompson (1905) reports on the production of 24 does studied in the vicinity of Altenburg, Geising, and Lauenstein, Switzerland. Nine of these does each produced from 600 to 700 liters of milk and four gave over 1,000 liters each per annum. The other 11 gave intermediate amounts. In Lebnitz, Switzerland, 10 goats were tested. Two of the animals each gave 600 to 700 liters and one over 1,200 liters per annum; the other seven produced amounts varying between these.

Jordan and Smith (1917) report the performance of 18 does tested at the New York Agricultural Experiment Station at Geneva. These does were of Toggenburg-American, Toggenburg-Angora, Saanen, Schwartzenberg, and Toggenburg breeding. The production ranged from 211.0 pounds, made by a Toggenburg-Angora doe, to 1,189.0 pounds, produced by a Short-Haired Toggenburg. The period of lactation with these does was from 250 to 300 days.

According to Voorhies (1921), at the California Agricultural Experiment Station, complete records of production were obtained from three does, of which two were Toggenburg and the third a grade Toggenburg. One of the Toggenburgs produced 2,158 pounds of milk in 312 days, and the other 1,118 pounds in 245 days. The grade doe produced 1,283.3 pounds of milk in 310 days.

[1]Experiment Station contribution No. 402. Part of the data included in this paper was presented by the junior author in a thesis for graduation, 1925, with the degree of Bachelor of Agriculture, from the College of Agriculture No. 237. The writers are indebted to Messrs. Leoncio Limpiado and Graciano Saniko for help in securing other data presented in this paper. Read before the Los Baños Biological Club, October 28, 1926. Received for publication, November 1, 1926.

Thompson (1905) states that goat's milk tests 4.6 per cent of fat. Jordan and Smith (1917) report the analysis of mixed goat's milk in which the test varies from 3.2 to 4.4 per cent, but generally 3.5 to 3.8 per cent. In data given by Voorhies (1921), the fat percentage was from 2.88 to 3.64 in the case of four Toggenburg does, while with one Toggenburg grade the test was 3.88 per cent. The total fat yield of the Toggenburgs was from 38.67 to 72.80 pounds, while the grade doe gave 49.73 pounds of fat.

OBJECTS

The objects of the study here reported were: (*a*) To determine the period of lactation of does in the Philippines; (*b*) to ascertain their milk production; and (*c*) to find out the fat test and fat production of these animals.

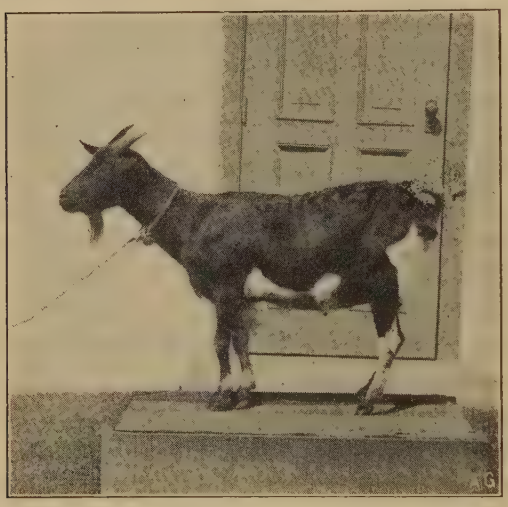

Fig. 1.—A type of native goat.

TIME AND PLACE

This investigation was carried out at the College of Agriculture, University of the Philippines. It covered a period of two years and six and one-half months, from February 1, 1924, to August 15, 1926.

MATERIALS AND METHODS

Does

Fourteen does were used in this investigation, of which six were native (see fig. 1) and eight Indian grades. The grades had one-fourth Indian blood with the exception of doe No. 37 which was one-half Indian (see fig. 2). All the does except doe No. 42 (native), which was very old, were young to medium in age. On the average, the native does weighed 27.7 kilograms, while the grades, being younger, averaged 25 kilograms. Doe No. 37, a half-Indian, was the largest doe and weighed 37.0 kilograms. (See table 1.)

Pens

For feeding the does and for shelter at night two pens, 2.5 × 4.5 meters, were constructed. In one pen the quarrelsome, stubborn does were placed and in the other the quiet ones. Adjoining one of the pens was a smaller one of 1.5 × 4.5 meters, in which the kids were put when they were

separated from the dams at night. These pens were so located as to be sheltered from driving rain and draft. Sufficient drainage was maintained by raising the floor in the pens. The fence was made of wire netting 1.20 meters high, nailed on ipil-ipil stakes, placed 1.20 meters apart.

TABLE 1

Showing the breeding, age, and size of milking does

DOE NO.	BREEDING	DATE KIDDED	WEIGHT[a]
			kgm.
34	Native	No record (medium age)	24.2
35	Native	No record (medium age)	29.2
36	Native	No record (medium age)	34.5
37	Indian grade	May 8, 1922	37.0
41	Native	No record (old)	27.0
42	Native	No record (medium age)	28.4
48	Indian grade	May 28, 1923	26.2
52	Indian grade	July 9, 1923	22.0
57	Indian grade	July 21, 1923	26.6
58	Indian grade	July 21, 1923	18.4
70	Indian grade	December 21, 1923	29.3
103	Indian grade	January 28, 1925	17.6
110	Indian grade	December 30, 1923	22.9
111	Native	No record (medium age)	22.6

[a] The weights were taken at the beginning of the last lactation.

Feed racks

Separate feed racks for roughage and grain were placed in the pens. For the kids large bamboo joints opened on one side proved very convenient for grain feeding. These feeders were tied on the fence high enough to prevent the kids from stepping on the feed.

Milking stand

A milking stand 60 centimeters above the ground was used. Over this a stanchion was built on one end and a railing on each side to prevent the doe from swinging her body. A trough was provided in front of the stanchion, in which grain was put for the doe to feed on during milking. (See fig. 2.)

Concentrates

A standard mixture of eight parts of corn, five parts of copra meal, and one part of rice bran, by weight, was used in feeding the does and kids at night. The corn was fed in kernels as the goats preferred it in that form.

Roughage

Besides the roughage obtained in the pastures during the day, the does and kids were supplied with Guinea grass, Napier grass or corn forage at night whenever one of these was available.

System of feeding

Milking does were fed day and night. In the daytime they were turned out with the main herd to graze on the pastures and in the evening they were given grain and roughage. Abundant roughage was placed in racks so the does could feed at will, and as much concentrates was furnished as the animals consumed readily.

The does had access to salt at all times.

Fresh water was placed in the corral at all times. The does on the pasture were taken to a watering place each noon.

Raising of kids

Does that kidded were taken immediately to a pen where they were confined for about two weeks. It was seen that the kids got the first milk,

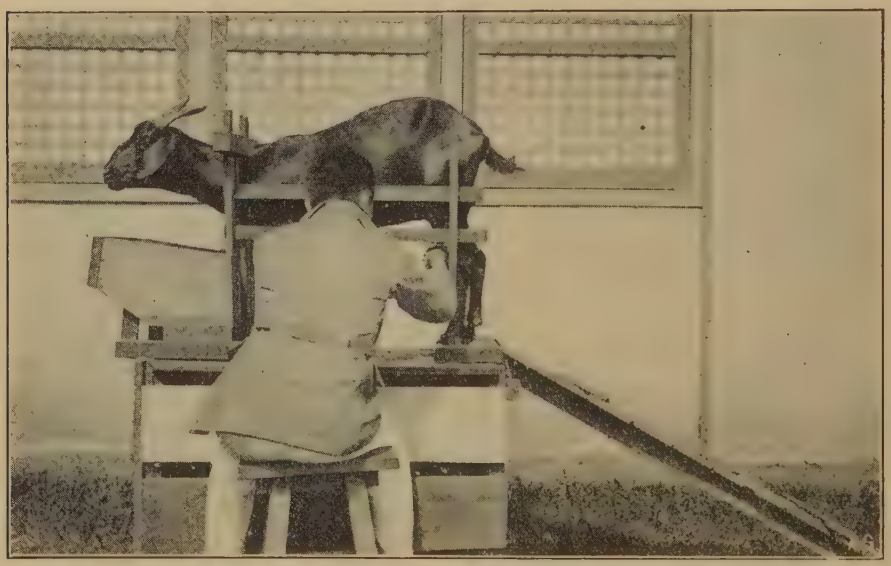

Fig. 2.—Doe No. 37, a half Indian grade goat on the milking stand.

or colostrum, which is important in ridding the system of the newly born kid of meconium. Starting on the sixth day after parturition the kids were separated from their dams at night and taken back in the morning after milking. Thus the kids received nourishment from their mothers only in the daytime while they were young. Later on, however, as they grew older, grain and grass were supplied to them at night.

System of milking

The does were milked at a reasonable distance from the pens so that the milk would be free from any unpleasant odor. At the first lactation the does were rather hard to milk, some of them lying down on the milking

platform. After a little patient training however, they became accustomed to the operation, and even so trained as to go up on the milking stand when their turn came.

At milking time, the does were brushed, particularly around the udder, and any excessive amount of hair on the udder was clipped. Immediately before milking, the udders were wiped with a damp cloth. The stripping method of milking was employed by which "the teat is grasped between the first finger and the thumb close to the udder and drawn down the entire length, sufficient pressure being exerted to cause the milk to flow freely" (Shaw, 1922). The milk was directed to a piece of sterilized cheese cloth covering the mouth of the receptacle, from which it was filtered again before bottling. The does were milked only in the morning.

Testing for butter fat

Sampling. Five cubic centimeters of milk were taken each time that a doe was milked. This quantity was accumulated for a ten-day sample which was afterwards analyzed for fat. Formaldehyde was used as preservative.

Testing. The Babcock method of testing for fat was used.

DISCUSSION OF RESULTS

Lactation

The period of lactation was computed from the sixth day after parturition, when actual milking was begun, up to the end of lactation. Twenty-five lactations are included in this investigation of which 11 were with the native does and 14 with the grades.

As may be seen in table 2, the period of lactation with the native does varied from 84 days to 196 days giving an average of 112.2 days. The grades milked for a period of from 67 days to 236 days, the average being 154.5 days. The length of lactation among the grade does may be expected to increase as they grow older.

The average lactation for both the native and grade does falls short of the lactations reported by Jordan and Smith (1917), with Saanen, Schwartzenberg, and grade Toggenburg does, which varied from 250 to 300 days, and those given by Voorhies (1921) with two Toggenburg does of 245 and 312 days duration.

Milk production

According to table 2, the lowest milk yield produced by the native does was 11,819 cubic centimeters, while the maximum yield was 92,515 cubic centimeters. The average milk yield produced by the native does was 34,029.7 cubic centimeters. Among the grades the lowest milk yield was 18,105 cubic centimeters, while the highest production was 158,100 cubic centimeters. The average milk yield of the grades amounted to

61,503.4 cubic centimeters, or almost double that of the natives. Owing to the relatively young age of the grades, their production may be expected to increase as they grow older.

TABLE 2

Showing the period of lactation, milk, and fat production of milking does

DOE NO.	DATE OF KIDDING	PERIOD OF LACTATION	TOTAL MILK PRODUCTION	MAXIMUM DAILY MILK PRODUCTION	AVERAGE FAT TEST	TOTAL FAT PRODUCTION[a]
		days	*cc.*	*cc.*	*per cent*	*grams*
Natives						
34	July 24, 1924	103	25,830	430	5.5	1,460.31
34	Sept. 27, 1925	94	21,680	430	5.6	1,247.98
35	Feb. 1, 1924	105	33,100	550	5.1	1,735.23
35	July 23, 1924	89	33,385	630	5.3	1,818.81
36	June 5, 1924	121	32,910	600	5.3	1,792.93
36	Nov. 22, 1924	196	92,515	740	3.4	3,233.33
36	July 9, 1925	123	53,000	680	4.1	2,233.67
41	June 13, 1924	86	11,819	270	4.1	498.11
41	Dec. 8, 1924	135	32,108	470	3.5	1,155.23
42	June 3, 1924	98	18,840	375	4.4	852.10
111	July 17, 1925	84	19,140	360	4.8	944.37
	Average	112.2	34,029.7	503.2	4.6	1,542.92
Grades						
37	June 15, 1924	156	77,245	900	4.4	3,493.67
37	Jan. 25, 1925	213	158,100	1,530	3.3	5,362.97
37	Nov. 24, 1925	236	155,115	1,040	4.5	7,175.06
48	April 9, 1924	115	32,530	600	4.0	1,337.53
48	Nov. 5, 1924	67	18,105	500	———	———
52	Dec. 10, 1924	193	39,620	450	4.2	1,710.50
57	April 19, 1924	103	26,170	535	4.4	1,144.03
57	Nov. 12, 1924	159	46,572	620	3.3	1,579.79
58	May 31, 1924	136	24,275	300	4.5	1,122.87
58	Sept. 19, 1925	100	25,630	460	4.1	1,080.00
70	Nov. 25, 1924	214	90,565	630	3.5	3,258.28
70	Sept. 28, 1925	145	65,995	690	4.9	3,323.99
103	April 27, 1926	104	25,060	450	4.4	1,143.73
110	Dec. 17, 1925	222	76,065	660	4.7	3,643.59
	Average	154.5	61,503.4	668.9	4.2	2,721.23

[a] A factor of 1,027.92, which is the average weight in grams of one liter of goat's milk, was used in computing the weight of milk production. From the gram-weight of milk production the corresponding amount of fat yield was determined.

As an indication of potentiality in the productive ability of the milking does, their maximum production of milk a day was recorded. In table 2, it may be seen that the maximum individual daily milk production of native does ranged from 270 cubic centimeters to 740 cubic centimeters, the average being 503.2 cubic centimeters. In the grades the lowest maximum daily production was 300 cubic centimeters while the highest daily production

amounted to 1,530 cubic centimeters. The average maximum daily milk production among the grade does was 668.9 cubic centimeters.

Comparing the average milk production of the native and grade does with those reported elsewhere, it is evident that these does rank lower. For instance, Thompson (1905) gives the lowest milk production of does in Switzerland at 600 liters, Jordan and Smith (1917) at 211.0 pounds in the case of a Toggenburg-Angora doe, and Voorhies (1921) at 1,118 pounds by a Toggenburg doe.

Fat test and fat production

According to table 2, the lowest fat test among native does was 3.4 per cent, and the richest milk averaged 5.6 per cent of fat. The general average of fat in the milk of all native does was 4.6 per cent. Likewise, the lowest total fat production among the native does was 1,247.98 grams, while the highest total production was 3,233.33 grams. The average fat yield among the native does for one lactation was 1,542.92 grams.

With the grades, the fat percentage of milk produced by the does ranged from 3.3 per cent to 4.9 per cent. The general average test of the milk of all does was 4.2 per cent of fat. In fat production the poorest yield amounted to 1,143.73 grams, and the highest was 5,362.97 grams. The average of fat produced by the grade does was 2,721.23 grams. On account of the increasingly greater amount of milk believed to be produced by does as they grow older, the fat production of the grade does may be expected to become more as they advance in age.

The general average fat test of 4.6 per cent of the milk of native does and 4.2 per cent among the grade does compare favorably with those reported by Jordan and Smith (1917), which ran from 3.5 to 3.8 per cent, and those given by Voorhies (1921) of 2.88, 3.64, and 3.88 per cent. Thompson (1905) gives the test as 4.6 per cent of fat.

Voorhies (1921) reports the fat yield of Toggenburg does as varying from 38.67 to 72.80 pounds, and 49.73 pounds for one Toggenburg doe, all of which is much higher than the average fat yield of the native and grade does in this investigation.

SUMMARY

Summarizing the results of this study, the following points are outstanding:

1. Fourteen does were studied, of which six were native and eight Indian grades. The native does were largely medium age and the grades young.

2. The native system of dairy management, in which the kids are allowed to go for part of the time with the dams until they wean themselves naturally, was followed and found to be practical and satisfactory.

3. The following average period of lactation, milk yield, fat test, and fat production were obtained:

	Native does	*Indian grades*
Lactation	112.2 days	154.5 days
Milk production	34,029.7 cc. (77.1 lbs.)	61,503.4 cc. (139.3 lbs.)
Fat test	4.6 per cent	4.2 per cent
Fat production	1,542.92 grams (3.4 lbs.)	2,721.23 grams (6.0 lbs.)

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THE EFFECT OF VARIOUS AMOUNTS OF COPRA MEAL AS A SUPPLEMENT IN RATIONS FOR LAYING HENS[1]

CORNELIO V. CRUCILLO

INTRODUCTION

Copra meal, owing to its abundance and cheapness, and rather high protein content, is attracting some attention as a feed for animals. It was found by Santos (1920) that copra meal contains many of the amino acids necessary for maintenance and for growth. Experiments reported by Cranfield in 1912 (?) and Carlier in 1913 showed that when copra meal was fed to dairy cattle, a richer milk which produced butter of a better keeping quality was obtained. Copra meal also was found to contain substances that have a stimulating effect on the mammary glands of milk goats (Fingerling, 1909). In the Philippines a considerable amount of work has been undertaken in the study of the feeding value of copra meal. Derecho (1921) of this College found copra meal, when fed alone, constipating with guinea pigs, but when used as supplement to Guinea grass it promoted growth and reproduction. Sulit (1926) found that when copra meal forms from 75 to 85 per cent of an otherwise complete ration, it is toxic and deleterious to guinea pigs and albino rats, but when about 37 per cent is present, it promotes health, vigor, growth, and normal reproduction. Goseco (1921) found that copra meal was very much inferior to snails when used as an ingredient in rations for ducks for egg production. Fronda (1919) and Buenaventura (1924), in their experiments with laying hens, also found that copra meal did not promote egg production as much as snails and cowpeas did. Taleon (1924), experimenting on the effect of copra meal as a mash supplement for laying hens, found that the hens receiving only the basal ration which consisted of corn, rice, and rice bran laid more eggs than the hens given ten per cent of copra meal supplement in the ration.

It appears from the above that copra meal is not a very desirable food for egg production. It is possible that these past workers did not use the correct proportion of copra meal in the ration. It must be remembered that egg production is not only influenced by the kinds of feeds given the hens but also by the methods and manner of feeding (Lee, 1924). Just what effect feeding various amounts of copra meal has upon the fertility and hatchability of the eggs and the vitality of chicks hatched from these eggs is also of great importance.

[1] Thesis presented for graduation, 1925, with the degree of Bachelor of Agriculture from the College of Agriculture, No. 238; Experiment Station contribution No. 403. Prepared in the Department of Animal Husbandry under the direction of Dr. F. M. Fronda.

The objects of this experiment may be stated as follows: (1) To find what effect the feeding of various amounts of copra meal ranging from ten to fifty per cent of the ration has upon: (*a*) the number and size of eggs produced; (*b*) the fertility and hatchability of these eggs: and (*c*) the vitality of the chicks hatched therefrom. (2) To determine whether or not copra meal may be recommended for practical feeding of laying hens and, if it can, to find the optimum amount that should be used.

This experiment was conducted in the College of Agriculture, Los Baños. It was started on January 26, 1924, and was closed on January 24, 1925, covering a period of one year.

MATERIALS AND METHODS

The flock

In this study sixty Native pullets and six cockerels were used. The pullets were bought in the Calamba market.

These pullets were selected from hundreds of chickens brought to Calamba from the surrounding region, so were fair representatives of Native chickens. They were about the same age and were almost mature. These pullets upon arriving at the College were numbered individually from 1 to 60 and were given the best of care so as to put them in good condition before the actual experiment began. About two weeks before the experiment was started the fowls were divided into six lots of ten birds each. In this process, great care was exercised to secure, as far as possible, for each lot a uniformity in size, vigor, health and other external indications of quality in the individual bird. A cock was placed in each lot. The lots were designated as lot I, lot II, lot III, lot IV, lot V, and lot VI.

Housing and yarding

Each lot occupied one fourth of an open front combination tile roof house. The internal dimensions of the house were 7.4 by 2.8 meters, which means that each compartment had approximately 5.18 square meters of floor space for each lot. The house was provided with roosts and a droppings board, and trapnests. It was found that two trapnests were sufficient for each lot. Two troughs, one for dry mash feeding and one for the drinking water, both made of bamboo, were provided. Each lot was allowed a grass range of 30 by 6 meters which was kept fairly well clipped.

Feeds and feeding

Feeds used. The basal ration or the stock mixture from which modifications were made was composed of the following:

(1) Grain { 1 part shelled corn
1 part palay

(2) Mash { 1 part corn meal
1 part rice bran

Lot 1, or the control lot, received this ration in the proportion of 1 part of grain to 1 part of mash. The ration for lot II contained 10 per cent of copra meal mixed with the mash. The ration for lot III contained 20 per cent copra meal; lot IV, 30 per cent; lot V, 40 per cent; and lot VI, 50 per cent. The following was the composition of the ration as prepared for each lot:

	Grain parts	*Basal mash parts*	*Copra meal parts*	*Copra meal per cent*
Lot I	5	5	Control	—
Lot II	5	4	1	10
Lot III	5	3	2	20
Lot IV	5	2	3	30
Lot V	5	1	4	40
Lot V	5	—	5	50

It should be noted that owing to the modifications made, the amounts of basal mash (1 part corn meal and 1 part rice bran) received by each lot decreased as the amount of copra meal increased, because a point was made of feeding the same amount of grain and mash to all of the lots.

Manner of feeding. It is the consensus of opinion that egg production is influenced, not only by the kinds of feed given the hen, but also by the manner of feeding. Great care in feeding was taken in this work, giving the birds as equal treatment as possible. Before the experiment proper was started, preliminary feeding work for a period of more than two months was undertaken. This gave a fairly good idea of how much food a certain number of hens could consume.

The grain was given twice a day regularly, between seven and eight o'clock in the morning, when about one third of the grain for the whole day was scattered in the grass in the yard, and between 4:30 and 5:30 p. m. when the remaining two-thirds was given. The mash mixture was fed in the self-feeding troughs which were kept open all the time during the progress of the experiment. At times when the birds were found not eating enough mash to maintain the required proportion, the amount of grain given in the morning was decreased so as to induce them to eat more mash. There were times when wet mash was given at noon so as to increase consumption.

The drinking troughs were cleaned every day and fresh water provided all the time.

Determining feed consumption. Each lot was provided with separate containers for grain and mash. At the beginning of each week the grain and the mash were weighed into these containers and then at the end of the week the portions left unconsumed were weighed. Thus, the actual amount of feed consumed each week was accurately determined and recorded.

Cleaning the houses

At the end of every week the droppings were scraped off the droppings board and the house cleaned. At first, the droppings were weighed with

the object of determining the amount produced every week, but as not all the birds roosted on the proper place, a considerable amount was lost, so the weighing was discontinued. The manure was put into a barrel placed in front of each house.

Collecting and recording the eggs produced

The eggs were gathered regularly between eleven and twelve o'clock in the morning and four and five o'clock in the afternoon. Collecting was also done at other hours of the day, when convenient.

Each egg was numbered with the number of the hen that laid it. Occasionally one or two eggs were found outside of the nest, on the ground or on the droppings board. These eggs were marked "X" and credited to the lot in which they were found. Between five and six o'clock in the afternoon of every day the eggs collected were weighed and recorded.

Breaking the broodiness of hens

No hen was allowed to sit. Whenever a hen became broody, she was confined in a broody coop, in a fattening cage, or in one of the compartments of the poultry house. When the broodiness of a hen in confinement was broken, she was released and put into her respective pen.

Testing the fertility and the hatchability of eggs

Artificial incubation was employed in hatching the eggs. As many hatches as was possible were made using the 130-hot water egg Queen Incubator and the hot water Buckeye incubator which had about the same capacity. The early hatches were conducted in a temporary incubation room and the later ones in the incubation cellar of the Department of Animal Husbandry.

About the same number of eggs from each lot was set each time. As recommended by Leoncio (1924), no eggs older than ten days were used. Small, off-shaped, thin-shelled, and dirty eggs were not incubated.

During the process of incubation the eggs were cooled from five to ten minutes, and from the third day turned morning and afternoon every day. Lippincott (1921) recommends the turning of eggs as frequently as possible. From the second week of incubation, every morning during very hot weather and at times when the humidity was very low the eggs were sprinkled with lukewarm water to mitigate the condition resulting from their rapid loss of water. The eggs were tested after the seventh day of incubation to determine the infertile eggs and those whose germs died during the first seven days of embryonic development. After two weeks of incubation, the remaining eggs were again tested to determine the germs that had died during the second week. On the eighteenth day, the eggs left were bagged and labeled with the number of the hen which laid them. On the twenty-second day the final checking was made. The chicks were weighed and legbanded and proper records made.

Study of chicks

After the chicks were weighed and leg-banded they were allowed a "hardening" of one day more in the incubator before they were taken out. They were put in a College fireless brooder which was the only "mother" the chicks knew during the time they were under observation.

Lippincott (1921) and Mussehl (1924) recommend that the young chicks be given their first feed about 48 hours after hatching. In this experiment the first feed was given the chicks 36 to 48 hours after hatching. The same feed was given to all, irrespective of the lot from which they came. The first feed consisted of a mixture of equal parts by weight of corn meal and rice bran made into a crumbling mash with a well-beaten egg. One egg a day was alloted to every 25 chicks.

After three days the ration used was as follows:

Rice bran	2 parts
Corn meal	1 part
Rice shorts (*binlid*)	1 part
Copra meal	1 part
Shrimps	1 part

Corn meal was substituted for rice shorts. To this ration a well-beaten egg was added and finely chopped young Guinea grass to furnish green feed which is very essential to the life of chicks. The "leg weakness" trouble which is so commonly reported in the United States, especially with early hatched chicks, is nearly always caused by lack of the elements which green feed furnishes (Mussehl, 1924).

The chicks were given as equal treatment as possible. To determine and compare the rate of growth from the different lots, the chicks were weighed at intervals of seven days from the first weighing up to and including the fourth week of life. After the fourth week the chicks were turned over to the department.

A careful record of mortality of the chicks was kept.

Observation on mortality of hens

Whenever a hen died she was opened and the cause of death determined.

Weighing of hens

The hens were weighed at the start of the experiment and at intervals of four weeks thereafter to note the increase or decrease in weight and thus determine whether or not they were receiving enough feed.

RESULTS AND DISCUSSIONS

Mortality of hens

The mortality results are given in table 1.

TABLE 1

Mortality of hens

LOTS	NUMBER OF HENS AT START OF EXPERIMENT	NUMBER OF HENS AT CLOSE OF EXPERIMENT	NUMBER OF HENS DIED	PERCENTAGE MORTALITY
I	10	9	1	10
II	10	9	1	10
III	10	6	4	40
IV	10	6	4	40
V	10	10	0	0
VI	10	9	1	10

From lot I (no copra meal) one hen died on March 30, 1924. She had not eaten for more than a week. Post-mortem examination of this hen revealed no sign of disease, but the bird was emaciated.

From lot II (10 per cent copra meal) one hen died on August 11, 1924, from the poisoning effects of a broken egg found rotting in the abdominal cavity. The contents of the egg had spread among the intestines which had become massed together.

From lot III (20 per cent copra meal) four hens died. The first death occurred on March 7, the second on March 13, the third on April 20, and the fourth on September 27, 1924. The cause of the deaths on March 17 and on April 20 was the poisoning effect of a broken egg found rotting in the abdominal cavity of each of the hens. The cause of the deaths on March 7 and September 27 could not be ascertained. Post-mortem examination of the hens revealed nothing unusual or abnormal. They were both in very good condition and were very active on the afternoon of the preceding day. Even the crop of one was full and that of the other half-full.

From lot IV (30 per cent copra meal) four hens died. One hen was found dead inside a nest on March 2, 1924. A thick fluid similar to a beaten egg was found oozing from the inside through the vent. The hen was posted immediately. The body was still warm when opened. In the oviduct was found a newly broken egg, part of which had spread in the abdominal cavity and part was oozing out as described above. The other organs of the body were normal. Apparently the hen died from the effects of this broken egg.

On March 16, 1924, two weeks later, another hen was found dead on the droppings board early in the morning. Post-mortem examination revealed nothing unusual or abnormal. The cause of death was not ascertained.

On May 11, 1924, the third death was registered. This hen showed inactivity and lack of appetite three days before this date and had been isolated. When her body was opened deposits of mucus were found along the linings of the œsophagus and on the upper wall of the mouth. Minute nodules were found on the intestines. The other internal organs were normal, if anything a little paler than normal. The condition of the hen was rather emaciated. The cause of death was diagnosed as roup with complications.

The fourth death was registered on September 20, 1924. The hen died in the hands of the writer after showing signs of severe pain and excessive exertion of energy. This hen was found in one of the nests with a broken soft-shelled egg just expelled. From the expression on her gradually darkening face it could be seen that she had great difficulty in expelling the egg; to this was attributed the cause of her death. When her body, still warm, was opened no trace of any disease or abnormality in condition could be found. She was apparently in perfect health.

From lot V (40 per cent copra meal) no birds died. It is to be noted that lot V received more copra meal than either lot III or lot IV.

From lot VI (50 per cent copra meal) only one hen died. The failure of this hen to expel a soft-shelled egg, which was found in the oviduct when her body was opened, was the cause of death. The hen died on February 6, 1924, 12 days after the experiment was started.

Feed consumption

The amounts of feed consumed by the birds from the different lots are given in table 2.

TABLE 2

Feed consumption

LOTS	GRAIN		MASH			TOTAL	AVERAGE CONSUMPTION PER BIRD PER YEAR
	Corn	Palay	Corn meal	Rice bran	Copra meal		
	kgm.	*kgm.*	*kgm.*	*kgm.*	*kgm.*	*kgm.*	*kgm.*
I	74.05	74.05	73.3	73.3	0	294.7	29.03
II	77.00	77.00	60.84	60.84	30.42	306.1	29.10
III	61.25	61.25	36.51	36.51	48.68	244.2	30.01
IV	61.90	61.90	24.38	24.38	73.14	245.7	30.07
V	80.75	80.75	16.13	16.13	129.04	322.8	29.43
VI	73.75	73.75	——	——	140.2	287.7	28.75

Average feed consumption per hen. The comparison of feed consumption can best be made by using the averages. In the computation of these figures the number of days gone through by the hens, including the birds which died, was taken so as to make the bases of comparison exactly the same. There is not very much difference in the amounts of feed consumed

by each bird from the different lots, as may be seen in table 2. This result was made possible through proper regulation of feeding. The average consumption falls around 29.0 kilograms a bird a year.

Proportion of grain to mash. Each lot consumed almost equal amounts of grain and mash. Lot I consumed 148.1 kilograms of grain and 146.5 kilograms of mash. Lot II consumed 154.0 kilograms of grain and 152.1 kilograms of mash. Lot III consumed 122.5 kilograms of grain and 121.7 kilograms of mash. Lot IV consumed 123.8 kilograms of grain and 121.9 kilograms of mash. Lot V consumed 161.5 kilograms of grains and 161.3 kilograms of mash. Lot VI consumed 147.5 kilograms of grain and 140.2 kilograms of mash.

In all cases the ratio of grain to mash approaches 1: 1. It will be observed, also, that the tendency was to eat more grain than mash. Judging from the attitude of the hens during the progress of the experiment they would have consumed very much more grain than mash had the grain not been limited.

Percentage of copra meal in the ration. The actual percentage of copra meal consumed by each lot, as computed from the actual feed consumption, is given in table 3. It may be seen that lot II consumed 30.42 kilograms of copra meal which was 9.94 per cent of the ration. Lot III consumed 48.68 kilograms of copra meal which was 19.93 per cent of the ration. The amount of copra meal consumed by lot IV was 73.14 kilograms or 29.77 per cent of the ration. Lot V consumed 129.04 kilograms of copra meal comprising 39.97 per cent of ration. Lot VI consumed 140.2 kilograms of copra meal making up 48.73 per cent of the ration.

Nutritive ratio. In computing the nutritive ratio the figures used were as follows (Tuason and Fronda, 1924):

	Crude protein per cent	*N-free extract per cent*	*Fat per cent*
Corn cracked	8.9	63.2	4.5
Corn meal	7.0	64.1	3.4
Rice, rough (palay)	4.7	61.4	1.7
Rice bran	6.9	34.1	6.3
Copra meal	15.8	36.6	5.8

TABLE 3

Percentage of copra meal in the ration and the actual nutritive ratio of the ration consumed

LOTS	PERCENTAGE OF COPRA MEAL		ACTUAL NUTRITIVE RATIO
	Intended	Actual	
I	0	0	1: 9.41
II	10	9.94	1: 8.21
III	20	19.93	1: 7.26
IV	30	29.76	1: 6.48
V	40	39.97	1: 5.81
VI	50	48.73	1: 5.34

Table 3 shows that the nutritive ratio was widest in lot I and narrowest in lot VI. From lot I to Lot VI the nutritive ratio narrowed gradually as the amount of copra meal in the ration increased. The nutritive ratio for lot I was 1: 9.41; lot II, 1: 8.21; lot III, 1: 7.26; lot IV, 1: 6.48; lot V, 1: 5.81; and lot VI, 1: 5.34. The ideal nutritive ratio according to Lee (1924) and Heuser (1920) is 1: 4.0 to 1: 5.0. Hence, among the different lots, the nutritive ratio for lot VI was the nearest to the ideal. As the amount of copra meal decreased in the ration the nutritive ratio became wider.

Weight and growth of the hens

The weights of the hens at the start and at the close of the experiment are given in table 4.

TABLE 4

Average weight and growth of hens

	LOT I	LOT II	LOT III	LOT IV	LOT V	LOT VI
	grams	*grams*	*grams*	*grams*	*grams*	*grams*
Average initial weight	1240.0	1257.5	1205.0	1222.5	1307.5	1230.0
Average final weight	1344.4	1436.1	1328.3	1591.7	1577.5	1447.2
Average increase	88.9	177.8	108.3	387.6	270.0	197.2

Of the nine hens from lot I that lived through the experiment three lost a total of 400 grams and six hens gained a total of 1200, giving a net gain of 800 grams or an average of 88.9 grams a hen. Of the nine hens from lot II which survived, seven gained a total of 1625 grams and one lost 25 grams, giving a net gain of 1600 grams, or an average increase of 177.8 grams a hen. Of the six hens left in lot III, five gained a total of 750 grams and one lost 100 grams, giving a net gain of 650 grams, or an average increase of 108.3 grams a hen. No hen from lot IV decreased in weight. The six hens which survived gained a total of 2325 grams, or an average increase of 387.6 grams a hen. From lot V, nine hens gained a total of 2800 grams and one hen lost 100 grams giving a net gain of 2700 grams, or an average increase of 270.0 grams a hen. From lot VI no hen decreased in weight. The nine hens which lived through the experiment gained a total of 1775 grams, or an average increase of 197.2 grams a hen. One of the remarkable things about the results is that all lots gained in weight. This seems to show that the birds were not underfed during the progress of the experiment. The hens from the lots fed with copra meal gained more weight than those from the control, or no-copra meal lot. The highest average increase in weight was registered in lot IV, the second highest in lot V. The rather high average increase in lot IV was due primarily to an unusual hen from that lot. This hen did not lay any egg during the progress of the experi-

ment and she gained 1050 grams in weight. Copra meal seems to furnish material for growth of hens and for fattening them. This result corroborates the results obtained by Taleon (1924).

EGG PRODUCTION

The results in egg production are given in tables 5 and 6.

TABLE 5

Egg production

	LOT I	LOT II	LOT III	LOT IV	LOT V	LOT VI
Total number of eggs produced	558	583	448	382	479	401
Percentage of egg production	16.70	16.78	17.43	14.59	13.16	12.20
Average number of eggs per hen per year	60.96	61.24	63.63	53.26	48.03	44.03

Percentage egg production. From the individual record of production alone or from the total number of eggs collected, it was impossible to compare the respective standing of each lot regarding this phase of the experiment, because the lots did not have an equal number of hens all the time. For this reason egg production was converted to the percentage basis in which the number of days gone through by the hens including those that died were taken into consideration, thus making the unit of comparison exactly the same. Table 5 gives the result of egg production computed on the percentage basis. The percentage of egg production is computed by dividing the total number of eggs laid by the total possible egg days and multiplying the result by 100.

Lot I gave a percentage production of 16.96, or an average yearly production of 60.96 eggs a hen. Lot II was credited with a percentage production of 16.78, or an average yearly production of 61.24 eggs a hen, which is only a fraction of an egg better than lot I. Lot III gave a percentage production of 17.43, or an average yearly production of 63.63 eggs a hen which is about three eggs better than the averages of lot I and lot II. The percentage production for lot IV was 14.59, or an average of 53.26 eggs a bird a year. Mention is again made of the hen which did not lay any egg. If this hen were excluded, the percentage production would be 16.56, or an average of 60.45 eggs a hen a year. Lot V gave a percentage production of 13.16, or an average yearly production of 48.03 eggs a hen. Lot VI gave a percentage of 12.20, or an average of only 44.51 eggs a hen a year.

The results show that copra meal when fed to laying hens, judiciously, may increase egg production. From the no-copra meal lot the curve of production goes upward to either lot III (20 per cent copra meal) or lot IV (30 per cent copra meal) as the peak and then falls down abruptly as the

amount of copra meal in the ration increases further. It is safe to say, therefore, that copra meal, when fed to make 20 to 30 per cent of the ration, gives some advantageous results; and that beyond 30 per cent the use of copra meal gives no additional advantage. These results seem to contradict those reported by Taleon (1924).

Considering the whole flock, the percentage production was 15.06, or an average of 54.97 eggs a hen a year. This result is very much better than the result obtained by Fronda (1919). The heaviest egg production was obtained in the months of January, February, and June. Beginning with the month of June there was a gradual decline in the rate of egg production up to and including December, when the hens laid very few eggs. During the months January, February, and March, the hens laid a fairly large number of eggs. After this time they declined in egg production until June, when they started laying again.

Individual egg production. Only two or three eggs from each lot were laid outside of the trapnests. In lot I the lowest individual production for one year was 52 and the highest was 71, showing a very close uniformity. In lot II the individual production ranged from 31 to 71, showing a wider variation. In lot III the lowest individual production was 31 eggs and highest was 86, showing a still wider variation. In lot IV the lowest was zero and the highest, 67 eggs. This shows the widest variation of all. In lot V, the individual egg production varied from 26 to 83. In lot VI it varied from 10 to 81.

The highest individual producer was from lot III with a record of 86 eggs, and the lowest producer was from lot IV with a zero record. Considering only the hens that laid, the lowest producer is from lot VI with a record of 10 eggs.

Weights of eggs. The results on the average weight of eggs are given in table 6.

TABLE 6

Weight of eggs

LOTS	NUMBER OF EGGS WEIGHED	TOTAL WEIGHT	AVERAGE WEIGHT
		grams	*grams*
I	558	21090	37.8
II	583	22719	39.0
III	448	17396	38.8
IV	382	14940	39.1
V	479	19749	41.2
VI	401	16265	40.6

The results tend to show that the feeding of copra meal to laying hens increases the size of eggs laid by the hens; that as the amount of copra meal increases up to and including 40 per cent of the ration there is a correspond-

ing increase in the weight of eggs; and that beyond this amount the egg weight decreases. However, there are other factors which may come in this category, the size of hens for example, the number of eggs laid, the time of laying and the age at which laying commences. Jull (1924) points out that he obtained a significant, although not very high, positive correlation between size of birds and size of eggs laid; that there is no significant correlation between egg weight and number produced; that the earlier in life laying commences the lower is the mean egg weight of the total production; that pullets attaining greatest maximum body weight tend to lay eggs of the greatest mean weight for the total production; and that age in days at which laying commences exercises a more significant direct effect on mean egg weight than does either maximum body weight or production. It will be seen by referring to table 4 that the lots which produced the heaviest eggs had also the largest hens.

Fertility and hatchability of eggs

The combined results of the seven incubation tests made are given in table 7.

TABLE 7

Fertility and hatchability of eggs

	LOT I	LOT II	LOT III	LOT IV	LOT V	LOT VI
Number of eggs incubated	143	144	106	85	110	91
Number of fertile eggs	123	127	102	77	88	80
Percentage of fertile eggs.	86.01	88.19	96.22	90.59	80.00	87.91
Percentage of D_1[a] from fertile eggs	13.98	16.54	6.86	14.29	11.36	13.75
Percentage of D_2[b] from fertile eggs	24.14	15.75	12.75	14.88	13.63	8.75
Percentage of D_3[c] from fertile eggs	27.64	31.50	28.43	29.87	28.41	27.50
Percentage of P[d] from fertile eggs	4.06	2.36	1.96	2.60	2.27	2.50
Percentage of hatched from all eggs	27.96	29.86	48.11	34.12	35.45	41.76
Percentage of hatched from fertile eggs	32.52	33.85	50.00	37.66	44.32	47.50

[a] D_1 Germs that died during first week of incubation.
[b] D_2 Germs that died during second week of incubation.
[c] D_3 Germs that died during third week of incubation.
[d] P Chicks pipped, but did not hatch.

Fertility. Of the 143 eggs incubated from lot I only 123 eggs were fertile, or 86.01 per cent. From lot II, 144 eggs were incubated of which 88.19 per cent were fertile. Although the difference between the percentage of fertility of lots I and II is not great, still the addition of ten per cent copra

meal to the ration appears to have increased the percentage of egg fertility. From lot III, 106 eggs were incubated, of which 102 were fertile, giving a percentage fertility of 96.22. This result may be due to the addition of twenty per cent copra meal. From lot IV, 85 eggs were incubated of which 79 were fertile giving a percentage fertility of 90.59. This result is better than that of the no-copra meal lot, although it is not so high as the result obtained from the twenty per cent copra meal-fed lot. From lot V, 110 eggs were incubated, 80 per cent of which were fertile. This is the lowest percentage of fertility among the different lots. From lot VI, 91 eggs were incubated of which 87.91 per cent were fertile.

The highest percentage of fertility was obtained from lot III, fed with 20 per cent copra meal, the second highest was from lot IV, given 30 per cent meal. The lowest was from lot V, the 40 per cent copra meal-fed lot.

A higher percentage of fertility was obtained from the 50 per cent copra meal-fed lot than from the 40 per cent copra meal-fed lot. This may be due to the fact that fewer eggs were produced from the former than from the latter, hence the chances of fertilization were greater in the 50 per cent copra meal-fed lot than in the 40 per cent copra meal-fed lot.

Taking all things into consideration, however, it appears that the addition of from twenty to thirty per cent copra meal affects the fertility of the eggs favorably, and that below and above this amount the effect is not marked.

Hatchability. Basing the percentage of hatchability upon the fertile eggs only, it may be seen in table 7 that the percentage of hatchability of eggs from lot I was 32.52; from lot II was 33.85; from lot III, 50; from lot IV, 37.66; from lot V, 44.32; and from lot VI, 47.50. These results tend to show that the eggs laid by hens given only the basal ration (without copra meal) gave the poorest hatch. The addition of ten per cent of copra meal had a very slight positive effect. The eggs from the 20 per cent copra meal-fed lot gave the best hatch. The percentage of hatchability suffered a marked fall when the copra meal was increased to 30 per cent, but as the copra meal in the ration was further increased the percentage of hatchability became higher so that it can not be said that the addition of copra meal beyond twenty per cent is productive of undesirable results. Under the conditions of this experiment the addition of twenty per cent copra meal proved to be the best.

Of the eggs that failed to hatch a large percentage had germs that died during the third week of incubation, and a small percentage pipped but did not hatch. The other deaths were equally distributed between the first week and the second week of incubation.

Observations with chicks

Weight and growth of chicks. Table 8 gives the results regarding weight and growth of chicks.

There was no appreciable difference between the average weights of one-day old chicks from the different lots although their relative size follows more or less the weight and size of the eggs as shown in table 6. The average weekly weights as well as the average relative weekly increases of these chicks are given in table 8. It may be seen that the chicks, irrespective of the lots from which they came, increased rapidly in weight. At the end of four weeks the chicks from lot I had an average increase in weight of 54.16 grams; the chicks from lot II, 70.04 grams; from lot III, 74.49 grams; from lot IV, 77.37 grams; from lot V, 69.45 grams; from lot VI, 60.24 grams. It is very evident from the results obtained that the addition of from ten to forty per cent of copra meal had a marked influence in producing eggs which grew into vigorous and fast-growing chicks. Between lot I (no copra meal) and lot II (10 per cent copra meal) the difference in the average rate of growth of chicks is very significant, showing how far-reaching was the effect of adding even a little amount of copra meal to the ration of the hens that laid the eggs from which these chicks were hatched. The addition of 20 per cent and 30 per cent copra meal was accompanied by a corresponding increase in the average rate of growth of chicks. When increased to 40 per cent and 50 per cent of the ration the growth declined gradually, but was better than if no copra meal had been fed.

Mortality of chicks. The most critical period in the life of chicks is their first four weeks of existence. Most of the deaths occur during this period (Enerva, 1926, and Dañgilan, 1926).

In this study the mortality of chicks during only their first four weeks of life is considered. Table 9 gives the results of this observation.

TABLE 9

Mortality of chicks

LOTS	NUMBER OF ONE-DAY OLD CHICKS	PERCENTAGE MORTALITY				
		First week	Second week	Third week	Fourth week	Total
I	34	8.82	14.70	20.59	2.93	47.05
II	32	15.62	15.62	15.62	0.00	46.86
III	44	9.09	6.82	18.18	6.82	40.91
IV	26	19.23	15.38	0.00	11.54	46.15
V	35	8.57	14.28	2.86	28.57	54.28
VI	35	14.28	20.00	2.86	22.86	60.00

The weekly percentages of mortality are given in the table, but they do not follow any regular curve, comparison by lots could not very well be made by using the weekly data. By combining the results of the four weeks into one, however, a clearer basis for comparison is formed. Out of the 34 chicks from lot I, sixteen died, giving a percentage of mortality of 47.05. Out of the 32 chicks from lot II, 15 died, giving a percentage mor-

TABLE 8

Average weight and growth of chicks

	LOT II			LOT III			LOT IV			LOT V			LOT VI		
ncrease	Number of chicks	Average weight	Increase	Number of chicks	Average weight	Increase	Number of chicks	Average weight	Increase	Number of chicks	Average weight	Increase	Number of chicks	Average weight	Increase
grams		*grams*	*grams*		*grams*	*grams*		*grams*	*grams*		*grams*	*grams*		*grams*	*grams*
	32	24.12		44	25.78		26	22.50		35	25.69		35	25.59	
9.73	27	32.90	8.78	40	36.05	10.27	21	35.70	13.20	32	35.68	9.99	30	36 68	11.09
15.79	22	56.50	23.60	37	62.80	26.75	17	59.13	23.43	27	61.83	26.15	23	53.60	16.92
16.08	17	76.80	20.30	29	86.59	23.79	17	75.89	16.76	26	81.33	19.50	22	74.52	20.92
12.56	17	94.16	17.36	26	100.08	13.49	14	99.87	23.98	16	95.11	13.81	14	85.83	11.31
56.16			70.04			74.49			77.37			69.45			60.24

	LOI I	
	Number of chicks	Average weight
		grams
One day.....	34	22.64
One week.....	31	32.37
Two weeks.....	26	48.16
Three weeks.....	19	64.24
Four weeks.....	18	76.80
Total increase.....		

tality of 46.86 which is only a fraction lower than that of lot I. Eighteen out of the 44 chicks from lot II died, giving a percentage mortality of 40.91 which is about six per cent lower than that of either lot I or lot II. Out of the 26 chicks from lot IV, 12 died, giving a percentage mortality of 46.15, which is almost equal to that of lot II. There were 35 chicks from lot V, 19 of which died, giving a percentage mortality of 54.28 which was very much higher than any of the other four lots mentioned. Of the 35 chicks from lot VI, 21 died, giving a percentage mortality of 60.00, the highest of all.

The results seem to show that the most vigorous chicks were produced from the hens fed with 20 per cent copra meal; that the effect upon the vitality of chicks produced from hens fed 10 per cent copra meal was not marked; and that beyond 30 per cent, the chicks produced became less and less vigorous as the amount of copra meal was increased. Considering the six lots as a whole, the percentage of mortality was rather high, being about 50. The chicks died fastest during their second week of existence. This corroborates the results obtained by Enerva (1926).

Relative cost of egg production

In table 2 the total amount of feeds consumed by each lot is given and in table 5 the total number of eggs produced by the different lots. The cost a kilogram of each feed was computed according to the following prices:

Feed	*Cost per kilogram*
Corn	₱0.0923
Palay	₱0.1165
Rice bran	₱0.0739
Copra meal	₱0.0568

The eggs were sold at 72 centavos a dozen, sometimes higher. All these figures were the averages of the actual prices of the feeds during the progress of the experiment.

TABLE 10

Relative cost of egg production

LOTS	TOTAL COST OF FEEDS	VALUE OF EGGS AT 6 CENTAVOS EACH	RETURNS ABOVE COST OF FEEDS
	pesos	*pesos*	*pesos*
I	27.63	33.48	5.85
II	27.91	34.98	7.07
III	21.61	26.88	5.27
IV	21.12	22.92	1.80
V	26.87	28.74	1.87
VI	23.35	24.06	0.71

In table 10, the relative cost of egg production of the different lots is compared.

It will be noted that there was a gain in every lot which, when combined, amounted to ₱22.57. A fair comparison can not be made by using the total gain of each lot because, as it was stated in the first part of this paper, the number of hens from the different lots was not equal all the time. For this reason table 11 in which is compared the cost of feeds consumed and the value of eggs produced per hen per year was devised.

TABLE 11

Comparative values of feed consumption and egg production per hen per year

LOTS	AVERAGE FEED CONSUMPTION	COST OF 1 KGM. OF FEED	COST OF FEED PER HEN PER YEAR	AVERAGE EGG PRODUCTION	EGG PRODUCTION PER HEN PER YEAR AT ₱0.06	GAIN ABOVE COST OF FEED PER HEN
	kgm.	*centavos*	*pesos*		*pesos*	*pesos*
I	29.03	9.375	2.722	60.96	3.658	.936
II	29.10	9.118	2.653	61.24	3.674	1.021
III	30.01	8.849	2.655	63.63	3.818	1.163
IV	30.07	8.596	2.585	53.26	3.196	.611
V	29.23	8.324	2.433	48.03	2.882	.449
VI	28.75	8.116	2.333	44.51	2.671	.338

The cost of feeds for keeping one hen in lot I was ₱2.722 and the value of eggs produced per hen was ₱3.658, giving a gain above cost of feeds of ₱.936 a hen. The cost of feeds for keeping one hen in lot II was ₱2.653 and the value of eggs produced per hen was ₱3.674, giving a gain above cost of feeds of ₱1.021, which is a little higher than that in lot I. The cost of feeds for keeping one hen in lot III was 2.655 and the value of eggs produced per hen was ₱3.818, giving a gain above cost of feeds of ₱1.163 a hen, which is higher than in either lot I or lot II. The cost of feeds for keeping one hen in lot IV was ₱2.585 and the value of eggs produced per hen was 3.196, giving a gain above cost of feeds of ₱.611 a hen, which is far below the others mentioned. Attention is again called to the fact that if the hen from this lot which did not lay any egg at all were disregarded in the computation, the gain above cost of feeds would be ₱1.042. The cost of feed for keeping one hen in lot V was ₱2.450 and the value of eggs produced was ₱2.882, giving a gain above cost of feed of ₱.432 a hen. The cost of feeds for keeping one hen in lot VI was ₱2.333 and the value of eggs produced a hen was ₱2.671, giving a gain above cost of feeds of ₱.338 a hen.

These results tend to show that the feeding of from 20 to 30 per cent copra meal is profitable and that beyond 30 per cent it may be better to feed no copra meal.

SUMMARY AND CONCLUSIONS

1. On the average, the hens from each lot gained in weight. The hens from the lots fed with copra meal gained more weight than those from

the no-copra meal lot. The two highest average increases in weights were registered from the 30 per cent and the 40 per cent copra meal-fed lots.

2. There was no appreciable difference in the amounts of feed consumed per bird from the different lots. The average feed consumption per bird per year was approximately 29 kilograms.

3. The highest rate of egg production was observed in the 20 per cent copra meal-fed lot and the second highest in the 10 per cent copra meal-fed lot, although the difference between the rates of egg production of these two lots and the no-copra meal lot is not very significant. The results tend to show that it may be advantageous to feed from 20 to 30 per cent copra meal and that 30 per cent appears to be the limit.

4. There was a tendency for the eggs to gradually become larger as the amount of copra meal was increased up to and including 40 per cent of the ration, beyond which amount a decrease in the size of the eggs was registered.

5. The addition of from 20 to 30 per cent copra meal seemed to have a decided influence upon the production of more fertile eggs; below and above this amount, this influence was not marked.

6. The addition of 20 per cent copra meal seemed to increase considerably the vitality of the eggs and hence their hatchability. Increasing further the amount of copra meal in the ration does not seem to have a bad effect on the vitality and hatchability of eggs.

7. The most vigorous and fast-growing chicks were hatched from the eggs of the hens fed with 20 per cent and 30 per cent copra meal. The lowest percentage of chick mortality was from the 20 per cent copra meal-fed lot. The percentage of chick mortality from the 40 per cent and 50 per cent copra meal-fed lots was high, tending to show that too much copra meal reduces the vitality of chicks.

9. A gain above cost of feeds was registered in every lot. The results tend to show that the feeding of from 20 to 30 per cent copra meal is more profitable than feeding no copra meal. Beyond 30 per cent, it is not profitable to feed copra meal.

10. Taking all things into consideration it seems that copra meal should be a valuable feed supplement for laying hens receiving corn and palay as grain feed, and corn meal and rice bran as mash, when fed within the limits of 20 per cent and 30 per cent of the whole feed.

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A FIELD TEST OF FIVE DIFFERENT VARIETIES OF SUGAR CANE AT HACIENDA CARMENCITA, PAMPANGA[1]

NICOLAS D. GRECIA

INTRODUCTION

One of the important factors affecting the yield of sugar cane is the variability in cane varieties. It is common knowledge that varieties differ in their adaptability to soil types and climatic conditions, and that some varieties are superior to others.

Dumas (1919) and Roxas (1918) both are of the opinion that our native varieties of cane are inferior to the canes imported from other countries. Dumas (1919), states that the native cane can hardly be grown at a profit at a normal price because of its poor ratooning quality. Roxas (1925) expresses the opinion that introduced varieties have better ratooning power than the native varieties. He further states that as no other quality of cane has a greater influence on profit than ratooning power, farmers should grow the introduced varieties, if only for the advantage of this quality. He points out the importance of making a specific study of the adaptability of cane varieties to locality in any effort to increase yield per hectare.

Review of important literature

Several workers in the Islands have published studies on different varieties of cane both native and imported. Roxas (1920) in his paper on "Comprehensive Plan of Investigation in Sugar Cane Agronomy and Chemistry" states that sugar cane is very susceptible to changes of conditions, and that the different varieties respond to these changes differently and demand food from the soil in different proportions. He cites that in Queensland, one variety took from the soil 163 pounds of potassium oxide (K_2O), 83 pounds of phosphoric acid (P_2O_5), and 96 pounds of nitrogen, while another took 139 pounds of potassium oxide (K_2O), 44 pounds of phosphoric acid (P_2O_5), and 105 pounds of nitrogen.

Hind (1920), in editorial comment about varieties in Hawaii, said that the Hawaiian planters are constantly changing their varieties. Lahaina, which at one time led all other varieties in popularity, has given way to Hawaii 109, a cane of Lahaina parentage. In another editorial, Hind

[1]Thesis presented for graduation, 1926, from the College of Agriculture with the degree of Bachelor of Science in Agriculture, No. 239; Experiment Station contribution No. 404. Prepared under the direction and general supervision of Dr. M. L. Roxas, Head of the Department of Agricultural Chemistry and Cane Technologist of the Philippine Sugar Association.

(1920) stated that the practice of planting the same variety without seed selection, season after season in one section, will result in serious deterioration in the quality of cane, and that its power to resist diseases and pests will be weakened. And that to insure profitable production and the control of serious diseases and pests, frequent changes to new varieties better adapted to the ever changing conditions is necessary. Lee and Medalla (1920) also expressed the opinion that diseases are best prevented by using resistant varieties. They cite M. E. T. Caum, of the experiment station of the H. S. P. A., who states that Yellow Caledonia is fairly resistant to the yellow stripe disease. They also found that the H-109 grown in the Philippines is highly resistant to this disease.

At Hacienda San Agustin in Isabela, Negros Occidental, owned by Mr. D. Montilla, a field test was conducted by Pritchett (1924) comparing Badila with Negros Purple, both as plant cane and first year ratoons. The experiment was carried out on one hectare of land which was divided into twenty plots, ten plots being used for each variety, alternating varieties in each plot so as to allow for variation in soil composition and treatment. Pritchett found that in first ratoons, Badila gave the greater yield in tons cane to the hectare as well as in sugar per unit weight of cane.

At Bacolod, Negros Occidental, an experiment was conducted by Lee (1924) comparing Yellow Caledonia with Negros Purple cane. The varieties were planted on the same day in alternating plots, and both were fertilized with 500 kilograms of "Big Crop" fertilizer per hectare. In this test the Negros Purple showed a greater yield in piculs sugar per hectare than Yellow Caledonia. Montilla (1925), Gamboa (1925), and Pritchett (1924) are of the opinion that Badila is the most promising variety in Negros. Gamboa (1925) gave results from his field test showing that Badila is superior to Negros Purple in plant cane as well as in ratoons. The results from his 1923-24 plant cane show that Badila gave an increase of 7.84 piculs sugar per hectare over Negros Purple. This field was ratooned in 1924-25 and Badila showed an increase of 55.72 piculs of sugar per hectare over Negros Purple. In the plant cane the difference may be insignificant, but in the ratoon the difference is so great that even allowing for a large probable error, which was not determined, it may safely be concluded that the odds are in favor of Badila. Carandang (1925) in a field test with Luzon White versus Cebu Purple versus Pampanga Red demonstrated that Cebu Purple was the highest producer both in cane and sugar. This variety also gave more sugar per ton cane than either of the other two varieties. Pampanga White was poorest in both sugar content and tonnage of cane per hectare.

Among the thirty-five varieties tested at Del Carmen, Pampanga, Roxas (1925) gave C. A. 12735 first place. This variety was followed by Hawaii 109 in second place, Badila in ninth place, Mauritius 1900 in fifteenth place, Cheribon in twentieth place and Cebu Purple in twenty-fifth. In

placing these varieties in the order of their superiority, consideration of such factors as susceptibility to diseases and pests, tons of cane and piculs of sugar per hectare, size of stalk and stooling habits of each variety, was taken.

Ross (1925) described the promising varieties grown at Del Carmen, Pampanga. His descriptions of four of the varieties used in the field test reported are given here:

M–1900.—A very rapid growing cane, reddish, short-jointed, resistant to drought, has not been known here to tassel at all, easily propagated, resistant to mosaic, and apparently to smut, high sucrose content, and easily harvested, as it sheds most of its leaves. Susceptible to the disease known as "Red Vascular" in Negros but which is easily controlled by seed selection. Good ratooner and canes seldom weigh less than two kilos. On poor soil has averaged easily 50 tons to the hectare, and on rich land ought to go as high as 80 to 100.

Cheribon.—At one time the standard cane in Java, is dark red vigorous growing cane, heavy stooler, big ratooner, canes weighing up to 2.5 kilos—grows well on poor sandy soils, tonnage running up to 50 to 60 tons. Is susceptible to mosaic, fiji and yellow spot, does not tassel out here, requires from thirteen to fifteen months to mature.

Hawaii 109.—A cane which has given some remarkable results in Hawaii, and even in a plantation near Del Carmen. Some remarkable results have been obtained on rather medium soil with fertilizer and irrigation. It yields 156 piculs to a hectare, a long jointed light purple cane, attaining quite a length and size under favorable conditions, very high sucrose content, but susceptible to every prevailing disease over here. With proper seed selection however, disease can be kept away in most cases.

Badila, or New Guinea 15.—Is a heavy dark purple cane, slow grower, big ratooner, heavy stooler, and very high in sucrose content. Except in poor soil it requires from thirteen to fifteen months to mature in. The common mistake is made of planting this cane too close. It requires to be planted in rows, five feet apart and about 18 inches to 2 feet apart in the rows, that is if it is intended to ratoon it to advantage.

Object of the present work

The object of the present work was to find the varieties of cane best adapted to the silt loams of Carmencita Hacienda, under the climatic conditions of southwestern Pampanga.

Time and place of the present work

Five varieties were planted in the month of January, 1925, at Hacienda Carmencita, Pampanga, and harvested in January, 1926[2]. Periodical observations were made from the time of planting until harvesting.

MATERIALS AND METHODS

Five different varieties were used: Badila, M-1900, H-109, Cheribon, and Cebu Purple. All of these varieties had been grown for several years at Hacienda Carmencita. The fertilizer used was "Big Crop".

[2] The writer gratefully acknowledges his indebtedness to Mr. Burnham, Resident Manager of Pampanga Sugar Mill, for permission to use the land and to Mr. W. Lewis, Manager of Hacienda Carmencita, for his help in securing laborers for planting, cultivation, fertilization, and irrigation.

Preparation of land

The land was prepared as is customary in this hacienda. The preparation was begun in October, 1925. After plowing the field five time with a native plow, it was rolled twice with a grooved iron roller to break the clods; then it was disk-harrowed. Furrows, 28 and 30 centimeters deep, were made by passing a middle breaker and following this with an ordinary moldboard plow.

Preparation and treatment of points

There could be no field selection as a pile of cut points were the only ones available for this experiment. Healthy points, however, with well developed eyes were selected from the pile just before the time of planting. The points were cut to 15 centimeters in length, allowing three eyes to each length so as to have a uniform number of eyes to the plot. All points were soaked in running water for thirty-six hours.

Methods of planting

One and one-fourth hectares of land were used for this experiment. This was divided into twenty-five plots of 500 square meters each. Five plots were used for each variety, so one variety occupied a total of one fourth of a hectare. Each plot contained twenty-one furrows. All plots received the same amount of fertilizer, at the rate of 777 kilograms per hectare. The fertilizer was given in two applications. The first application, 12 grams to the stool, equivalent to 252 kilograms to the hectare, was at the time of planting. The second application, 25 grams to the stool, equivalent to 525 kilograms to the hectare, was about two months after planting. In both cases the fertilizer was placed in holes five to seven centimeters deep near each stool, where the soil is moist.

The points were planted almost flat in the ground about 20 centimeters deep, and covered with soil to a depth of about 10 centimeters. To a plot, 1050 points, or 50 points to a furrow, were used. This planting is at the rate of 21,000 points to the hectare. This number of points is less than is the practice in this district; the lesser number was used with the expectation of getting good first ratoons. The furrows were one meter apart, and the points were set about 30 centimeters apart in the furrows.

The plots were arranged in such a way that each variety was planted in different parts of the field. This was to minimize the error due to variations in the soil. The arrangement of the plots is shown in the chart.

CHART 1.—*Showing the planting plan*

X	A	B	C	D
B	C	D	X	A
C	D	X	A	B
D	X	A	B	C
A	B	C	D	X

Legend:
A: Hawaii 109
B: Badila
C: Mauritius Seedling 1900
D: Cheribon
X: Cebu Purple

Size of the plot:
20×25 m. = 500 square meters

Distancing:
1 meter between furrows
30 centimeters between points

Number of furrows:
21 furrows per plot
105 furrows per variety
525 furrows total

Cultivation and care

All vacant hills were replanted about two months after planting. Replanting was done after counting the germination of the original planting. For each plot and variety the number of points replanted was noted. The field was cultivated six times with a Calamba cultivator, and was hoed twice. It was off-barred and hilled up twice with plows. The purpose of the cultivation was to kill the weeds and to restore the mulch after a rain or an irrigation. Off-barring and hilling up was done just before the cane closed in, following the common practice in this hacienda.

Irrigation

The field was irrigated four times before the rainy season began. The water was applied in furrows made with a plow along both sides of the rows of cane. All plots were given as uniform treatment as possible.

Harvesting

Each plot was harvested separately. The stalks were cut below the surface of the ground. The cane from each plot was loaded on three-ton flare-sided cars, sent to the mill within 36 hours, and weighed and analyzed separately. Weighing and analysis of the cane were under the supervision of the chemist, Mr. F. Fukumoto.

EXPERIMENT AND RESULTS

Table I gives the computed percentage of germination of each variety based on the number of eyes and points planted. The counting was done with the help of a tally-punch. The number of stools was first counted, then the stalks. The average weight per stalk for each variety was computed by adding the weight of cane of the five plots of each variety, and dividing by the total number of stalks of each variety. The result is shown in table 1.

TABLE 1

Showing percentage of germination, number of stalks per stool, weight per stalk, and number of stools and stalks just before harvesting

VARIETY	FIRST COUNT		PERCENTAGE OF GERMINATION		SECONT COUNT (ONLY MILLABLE STALKS)		NO. OF STALKS PER STOOL	WEIGHT PER STALKS
	Stools	Stalks	Stools	Stalks	Stools	Stalks		
								kgm.
H–109	4073	9542	77.57 ±3.89	60.39 ±3.37	3252	7333	2	1.64
Badila	3928	9256	76.72 ±4.12	58.78 ±5.26	3580	7315	2	1.63
M–1900	4103	12308	78.15 ±2.16	78.15 ±3.40	3614	8230	3	1.46
Cheribon	2830	8879	53.90 ±3.65	56.37 ±4.08	2730	8102	4	1.15
Cebu Purple	2136	6543	40.68 ±5.38	41.53 ±5.15	2050	5460	3	1.15

Field observations

Observation of the plots was made at least once a week, notes being made on the prevalence of diseases and pests. Counts of stalks attacked by mosaic, Fiji, smut, rats, and borers were taken.

M-1900 was observed to be the fastest grower, followed by Cheribon, Badila, H-109, and Cebu Purple in order named. Of the five varieties, Cebu Purple and H-109 were the least hardy.

Cheribon, Cebu Purple, and M-1900 were good stoolers; Badila and H-109, poor. With the exception of Cheribon, all varieties tasseled.

The results

Table 1 gives the number of stools and stalks and the percentage of germination of each variety. Table 2 gives the average tonnage and analysis of each variety. Table 3 gives the number and percentage of stalks of each variety attacked by disease and pests. Table 4 is a summary table.

TABLE 2

Showing the tonnage and analysis of the different varieties

VARIETY	JUICE ANALYSIS		QUALITY RATIO	TONS CANE PER HECTARE	PICULS SUGAR PER HECTARE
	Brix	Purity			
Badila	21.63	90.09	6.94	59.55±2.15	135.57±4.90
M–1900	21.46	90.22	7.05	60.36±2.16	135.57±5.85
H–109	19.24	89.14	8.08	60.35±3.45	118.67±6.75
Cheribon	18.07	84.86	9.31	56.08±2.10	95.24±1.99
Cebu Purple	21.49	90.48	6.89	30.81±2.12	70.70±4.89

DISCUSSION OF RESULTS

Mauritius Seedling 1900 had the highest percentage of germination and largest number of stalks, followed closely H-109. Badila, Cheribon, and Cebu Purple in these two points ranked in the order named. Cheribon was the best stooler, Mauritius 1900 and Cebu Purple being close seconds. H-109 produced the heaviest cane, weighing 1.64 kilograms a stalk; Badila was second with 1.63 kilograms, M-1900, third, with 1.46; Cheribon, fourth, with 1.36.; Cebu Purple with 1.15 kilograms a stalk produced the lightest cane.

Table 2 gives the tonnages of cane and piculs of sugar per hectare, for the five varieties, with their corresponding probable errors[3]. Badila, M-1900, and H-109 gave practically the same weights of cane and piculs of sugar per hectare. This equality is shown in table 4, which indicates that there are no significant differences in yields in these three varieties.

[3]The probable errors were determined by the following formulæ:

$$P.\ E.\ M. = \pm 0.6745\sqrt{\frac{\leqq d^2}{n\ (n-1)}},$$

where *P. E. M.* stands for the probable error of the mean, *d* refers to the summation of the deviation of the different items from the mean, and *n* to the number of items. *n* in this experiment is five which refers to the five replications for each variety. The probable error of the difference is $\sqrt{a^2+b^2}$, where *a* stands for the probable error of the mean of one variety and *b* stands for the other. The probable error of the difference is multiplied three times and if greater than the actual difference between two things compared, then the difference is insignificant, when less, the difference is significant.

TABLE 3

Showing the total number and the percentage of stalks attacked by diseases and pests

VARIETY	NUMBER OF STALKS ATTACKED BY DISEASES			NUMBER OF STALKS ATTACKED BY PESTS		PERCENTAGE OF STALKS ATTACKED BY DISEASES			PERCENTAGE OF STALKS ATTACKED BY PESTS		REMARKS
	Mosaic	Fiji	Smut	Rats	Borers	Mosaic	Fiji	Smut	Rats	Borers	
Hawaii 109	240	None	9	179	149	3.40	Ncne	0.12	2.38	2.03	Tasseling and some lalas
Badila	91	None	22	278	202	1.24	None	0.30	3.80	2.78	Tasseling and some lalas
M–1900	43	None	1	1220	230	0.52	None	0.01	14.82	2.79	Tasseling and some lalas
Cheribon	337	1	None	234	181	4.15	0.01	None	2.88	2.23	Not tasseling but lalas
Cebu Purple	265	None	10	46	229	5.04	None	0.18	0.88	0.85	Tasseling and some lalas

TABLE 4

Summary of the results of the different varieties

YIELD

VARIETY COMPARED	DIFFERENCE IN TONS CANE PER HECTARE	VALUE OF DIFFERENCE	DIFFERENCE IN PICULS SUGAR PER HECTARE	VALUE OF DIFFERENCE
Badila over H–109	—0.80 ± 4.05	Insignificant	17.00 ± 8.34	Insignificant
Badila over M–1900	—0.81 ± 3.40	Insignificant	0.20 ± 7.62	Insignificant
Badila over Cheribon	3.47 ± 3.00	Insignificant	40.45 ± 5.29	Very significant
Badila over Cebu Purple	8.74 ± 3.02	Very significant	64.97 ± 6.91	Very significant

GERMINATION

VARIETY COMPARED	DIFFERENCE IN STALKS GERMINATED	VALUE OF DIFFERENCE	DIFFERENCE IN STOOLS GERMINATED	VALUE OF DIFFERENCE
M–1900 over H–109	17.73 ± 4.77	Significant	0.58 ± 4.45	Insignificant
M–1900 over Badila	19.34 ± 6.36	Significant	1.43 ± 4.65	Insignificant
M–1900 over Cheribon	21.75 ± 4.35	Very significant	24.25 ± 4.24	Very significant
M–1900 over Cebu Purple	36.59 ± 6.25	Very significant	37.47 ± 5.80	Very significant

Cheribon gave practically the same tonnage of cane, but fewer piculs of sugar per hectare. The difference between the yields of Badila and Cheribon in piculs of sugar to the hectare was 40.45 ± 5.29. This difference is very significant. Cebu Purple gave the lowest yield, both in tons of cane and piculs of sugar to the hectare. The differences between Badila and Cebu Purple are 28.74 ± 3.02 tons of cane and 64.97 ± 6.91 piculs of sugar to the hectare, in favor of Badila.

Table 3 shows the number and percentage of stalks of each variety attacked by diseases and pests. Mauritius 1900 was the most susceptible to rats, with Badila, Cheribon, H-109, and Cebu Purple following in the order named. Cebu Purple was the least attacked by rats, perhaps because it lodged least of all. H-109, Cheribon, M-1900, and Badila were about

equally affected by borers; Cebu Purple and Cheribon were very susceptible to mosaic, H-109 less so, and M-1900 and Badila were but slightly attacked; Cebu Purple, H-109, and M-1900 were silghtly attacked by smut, Cheribon not at all. Cases of Fiji were found only in Cheribon.

SUMMARY OF CONCLUSIONS

1. Mauritius Seedling 1900, Badila, and H-109 gave practically the same yields both in tons of cane and piculs of sugar to the hectare. They were heavier yielders in piculs of sugar than either Cheribon or Cebu Purple.

2. Cheribon and Cebu Purple gave poorer germination than Mauritius Seedling 1900, Hawaii 109, or Badila, and were very susceptible to mosaic. Mauritius Seedling 1900 was the most susceptible to attack by rats, perhaps because it lodged badly in this experiment.

RECOMMENDATION

Inasmuch as the results reported in this paper are for plant cane, and conclusive evidence of the superiority of one variety over another must include results with the ratoons, it is recommended that these experiments be extended to include one or two ratoons before definite conclusions are drawn.

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ABSTRACTS[1]

Leafspot of maize caused by Ophiobolus heterostrophus n. sp., the ascigerous stage of a Helminthosporium exhibiting bipolar germination. CHARLES DRECHSLER. *Journal of Agricultural Research* **31:** 701–726. *Pl. 1, 2. fig. 1–5.* 1925. The author reports that a leafspot disease caused by *Ophiobolus heterostrophus* n. sp. was found on maize and teosinte in the Philippines and on maize in Florida. The symptoms are characterized by numerous ribbon-like, cinnamon-buff lesions measuring from 5 to 15 millimeters in length and from 1 to 3 millimeters in width. The lesions are surrounded by a reddish-brown margin. The young spots are elliptical. Later, they elongate with lateral edges parallel and coinciding exactly with the course of the veins. The old spots often coalesce forming large dead areas. The lesions on teosinte are longer than those on maize. They may attain a length of 3 centimeters but their lateral edges do not coincide as closely with the veins of teosinte as on maize.

The conidia and conidiophores are produced sparsely on the middle of the lesions. The conidiophores are olivaceous and their septa occur at intervals of 15 to 60 microns. They arise singly, or in groups of two or three from the stomata, and measure from 120 to 170 microns in length and from 4.5 to 7.0 microns in diameter. The attachment of spores to the conidiophores is shown by scars, which are 10 to 40 microns from each other at geniculations. Under moist conditions the conidiophores developed into irregularly branching sporophoric filaments which often reach a length of one millimeter or more.

The conidia are light or moderate olivaceous, strongly curved, and abundantly septate. They taper moderately at the ends. They measure from 30 to 115 microns in length and from 10 to 17 microns in width. A conidium germinates by the production of two germ tubes, one from the apical end and the other from the basal end. The bipolar germination of the conidia distinguishes *O. heterostrophus* from numerous species of allied forms assigned to the genus.

The perithecia developed on the dead tissues when the diseased maize leaves were placed in the damp chamber. The perithecia are black and subglobose. Each of them has a well-defined ostiole and often bears variable number of conidiophores.

Asci are produced abundantly inside the perithecium. They are subcylindrical and have short stipes and rounded apices. They measure from 160 to 180 microns in length and from 24 to 28 microns in width. Each

[1] Abstracts prepared as part of the required work in English 6, College of Agriculture.

ascus bears typically four filamentous, cylindrical, multiseptate ascospores which are arranged in a close helix.

The ascospores are liberated by the rupture of the ascus toward the apex. They are discharged from the perithecia through the ostiole. An ascospore germinates by the production of germ tubes from any or all segments.

Numerous water-soaked lesions ranging from 1.0 to 2.5 millimeters in diameter were produced on maize 36 hours after inoculation with *O. heterostrophus*. The mature lesions on the inoculated maize foliage were the same as those on the original specimens. When the same fungus was inoculated on rice and sugar cane plants, it failed to produce anything but incipient infections on the foliage. The incipient lesions grew neither in size nor in length.

—*Abstract by Macario A. Palo.*

The effect of carbon bisulfide upon the viability of leguminous seeds. José A. Saguin. (*Thesis presented for graduation, 1925, from the College of Agriculture, No.* 240; *Experiment Station contribution No.* 405).—Nine kinds of leguminous seeds, cowpea, mungo, peanut, two varieties of velvet bean, alfalfa, soybean, *crotolaria* and (black) "otong balatong" containing different amounts of water were used by the author in finding the effect of carbon bisulfide upon viability of leguminous seeds. The seeds were divided into three lots: (1) where the seeds were dried over calcium chloride; (2) where the seeds were dried under laboratory conditions; and (3) where the seeds were soaked in water.

The seeds in the three lots were placed in small-sized cloth bags and were exposed for different lengths of time to the vapor of carbon bisulfide solution contained in an air-tight bottle.

The author reports that the viability of the seeds studied was affected by carbon bisulfide; that different varieties of leguminous seeds showed varying degrees of resistance to carbon bisulfide; and "that the resistance of seeds to carbon bisulfide varied inversely to the water content. Also application of small amount of carbon bisulfide stimulates germination and growth.

—*Abstract by Gaudencio A. Ventura.*

The true beginning of wisdom is the desire for discipline.

EXCHANGE NOTES

Fruit syrup is increasingly popular among the Chinese as a cold summer drink. Formerly, only important syrups could be obtained; but now six companies in Shanghai are engaged in the manufacture. Fruit syrup does not involve many complications in manufacture. The process employed by local manufacturers generally consists of boiling the fruit in sanitary boilers, thereby extracting the liquid. With the addition of sugar and alcohol the syrup is ready for sale after bottling, the quality of the syrup depends upon the fruit employed. The fruit must be fresh and the syrup must not be extracted in too great a quantity, or there will be sediment at the bottom of the bottles, so reducing the quality.

Chinese use fruit syrups in two forms. First, they are taken as a cold drink. For this one part of fruit syrup is mixed with ten parts of cold boiled water. This form of drink is popular in Shanghai because of the very many varieties of syrups to be had, and in the interior because in many places aërated waters are not available. Secondly, the syrup is very often mixed with Chinese kaoliang and other kinds of wine. Kaoliang wine is colourless, but with fruit syrup it turns into a brilliant colour. Bottles of fruit syrup are often given as presents to relatives and friends on festival days.

There are about twenty-one kinds of syrup sold by the Talow Canning Factory in Shanghai. They are lemon, almond, strawberry, peach, loquat, pear, banana, orange, apricot, cherry, mulberry, peppermint, apple, pine-apple, grape, rose, olea fragrans, tender ginger shoots, sarsaparilla, bergamot, and aromatic grasses.

—*Agricultural Journal* (Queensland).

Forty farmers in Metamora, Illinois, school district are attending a night school and receiving instruction in testing seed corn. W. S. Dyar, teacher of agriculture, is conducting the school. More than 15,000 ears of corn have been tested with germination running from 35 to 85 per cent.

—*The Prairie Farmer* (Illinois).

As the demand for peanuts for all purposes is increasing very rapidly, the future of the industry seems assured. It only remains for growers to organize and improve their knowledge of the crop and methods of culture in order to take advantage of the opportunities offered by the industry.

—*Journal of the Department of Agriculture* (Union of South Africa).

Passiflora edulis, the passion fruit, is a handsome climbing plant with whitish flowers about two inches in diameter and fruit of the size and shape of a hen's egg but purple in colour somewhat like that of the egg-plant. The fruit has a tough skin, filled with a jelly-like substance, in which the seeds are embedded.

The flavour of the fruit is as delicious as it is unique, and is a great favourite where it is known.

In Australia, where it is largely grown, passion fruit is in great demand for dessert and also as the principal ingredient of fruit salad. The fruit keeps and carries well and has a ready sale in Australia, fetching from 15*s*. to 25*s*. per bushel case in the Melbourne market according to season and quality.

The cultivation of the passion vine is not one which presents any great difficulty * * * .

—*Agriculture Journal* (Nicosia, Cyprus).

Milk and cream consumption in the United States last year was the largest in history—1.2 pints person per day.

—*The Prairie Farmer* (Illinois).

Agricultural engineering has been classified as one of the industrial branches of engineering. That is, it is the application of civil, mechanical, and electrical engineering—what we may call the fundamental branches—to a particular industry, the agricultural industry. The agricultural engineer, therefore, may be defined as an engineer with an engineering training and an agricultural background. His job is to solve the engineering problems peculiar to the agricultural industry. And if there is no justification for agricultural engineering, then there is no justification for the old-established profession of mining engineering, or highway engineering, automotive engineering, or any of the other industrial branches of engineering. As a matter of fact, however, the day is past when there is need to defend agricultural engineering in well-informed circles.—Raymond Olney.

—*Agricultural Engineering.*

A legume in the rotation at the Kansas agricultural college increased the wheat yield 6.5 bushels per acre and raised the protein content of the wheat 1.7 per cent.

—*Successful Farming* (Iowa).

COLLEGE AND ALUMNI NOTES

Marquis Y. Tokugawa and Mr. Eikichi Kamada, members of the Japanese House of Peers, and Professor Junjiso Shimasono, noted educator, visited the College recently. They exhibited much interest in the various phases of the work on the campus.

Marquis Tokugawa is a descendant of the Tokugawas who from 1603 to 1868 were the real rulers of Japan from their capital Yedo (Tokyo).

Mr. and Mrs. J. E. Hayden and Mr. Roy Bennett were recent College visitors. Mr. Hayden is Washington Correspondent for the *Detroit News* and Mr. Bennett is Editor of the *Manila Daily Bulletin*. Mr. Hayden was sent by the *Detroit News* to the Philippines for material for a series of articles.

Dr. Bienvenido M. Gonzalez sailed for Japan on October 4, to attend the meeting of the Pan-Pacific Science Congress as one of the official delegates of the University of the Philippines. Doctor Gonzalez left a few days earlier than did other delegates so that he might join the party of scientists visiting Northern Japan. Doctor Gonzalez hopes to make a survey of the Animal Husbandry of Japan and to obtain data that may be of use in Philippine work.

Dr. Nemesio B. Mendiola is soon leaving on the year's Research fellowship awarded him by the International Education Board. Doctor Mendiola will spend his year in Java, associated with prominent Dutch plant breeders and expects to accomplish work that will be of great future value to Philippine agriculture.

Miss Margaret E. Fountaine, F. E. S., who spent some months in this locality in 1924, studying and collecting butterflies, published a series of articles on her Los Baños material in *The Entomologist* for 1925.

Professor C. P. Johnson writes that the trip back to the United States on the Army Transport took only 18 actual sailing days and cost only $92 for the family. On arrival he bought a second hand car, and the family toured about Central California, visiting friends. They found San Francisco cold and foggy. Professor Johnson will be regularly engaged in teaching Farm Mechanics at an early date.

The twenty-second scientific meeting of the Los Baños Biological Club was held on September 23, 1926, at 7:30 p. m. in the College of Agriculture Auditorium.

The following papers were read and discussed:

1. Dr. Francisco Fronda—"Studies on the fertility of the hen's egg."
2. Dr. Zacarias de Jesus—"Cysticercosis in the native swine."
3. Dr. Bienvenido M. Gonzalez—"Observations on the duration of service and serviceable life of a work cattle".

The Student Mess, which has just been rebuilt and enlarged, was opened to the boarders October 1, 1926. The most important improvements made are: a special dining room for guests, a large first class kitchen (the best on the Campus), and wide porch. The charges are the same as before, that is ₱17.50 a month. Special dishes will be prepared on request.

Mr. Ramon A. Cruz, graduate assistant in the Chemistry Department Experiment Station, resigned October 1, 1926. Mr. Cruz has accepted a position as Assistant Chemist in the Malabon Sugar Refining Company at ₱175.00 a month, a compensation that is more than twice what he was getting in the College.

Mr. Geronimo Flores, B. Agr. '23, has been appointed as graduate assistant in the Chemistry Department, *vice* Mr. Gregorio Joven.

Mr. Emilio Velasquez, recently appointed graduate assistant in Chemistry, passed the civil service examination in Pharmacy.

The Mimics (Dramatic Club) presented three one act plays on September 11, 1926, at College of Agriculture auditorium.

The plays were:

"JEAN VALJEAN"

Cast of Characters

Jean Valjean	Agapito Muyargas
The Bishop	Gaudencio Ventura
Mademoiselle, the Bishop's sister	Miss Victoria Mendiola
Madame, his housekeeper	Miss Leonisa Villegas
Officer	Fortunato Basilio

THE BEAU OF BATH

By Constance D'Arcy Mackey

Cast of Characters

Beau Nash	Domingo Cayabyab
Jepson, his servant	Nicolas Florese
The Lady of the Portrait	Miss Catalina Natividad

THE RISING OF THE MOON

By Lady Gregory

Cast of Characters

Sergeant	Constancio Medrana
Policeman X	Victoriano Lopez
Policeman B	Fortunato Basilio
A Ragged Man	Filemon Español

The plays were directed by:

Miss Margaret Wilson and
Miss Marcia Whipple

Mr. Moises Villaluz was *Art Director*

The directors of the Mimics deserve high praise for the selection and careful presentation of the plays.

The scenes painted especially for the plays by Mr. Villaluz were most pleasing bits of scenic artistry and added greatly to the realism and beauty of the dramas. The appreciation of the student audience was manifested by hearty applause at each rising of the curtain.

New books and other publications added to the Library, College of Agriculture, between July 31 to September 30, 1926

Adkins, H. et al
An introduction to the practice of organic chemistry in the laboratory. 1925.

Baker, S.
The fauna of British India (Birds). Vol. III. 1926.

Buchanan, I. R.
The women of the bible. 1925.

Church, A. J.
The story of the Odyssey. 1925.

Connecticut State geological and natural history survey, vols. 1-6, 1904-1920.

Enders, E. C.
Temple bells and silver sails. 1925.

Hedrick, U. P.
Systematic pomology. 1925.

Hume, H. H.
The cultivation of citrus fruits. 1926.

Kemmerer, E. W.
Modern currency reforms. 1916.

Kipling, Rudyard
Collected verses. 1925.

Kipling, Rudyard
The jungle book. 1926.

Kipling, Rudyard
Kim. 1926.

Lägerlof, S.
The wonderful adventure of Nils. 1926.

Lang, W. H. (Ed.)
Strasburger's text-book of Botany. 1921.

Loeb, J.
Proteins and the theory of colloidal behavior. 1924.
Maulik, S.
The fauna of British India (Coleoptera). 1926.
Merrill, E. D.
An enumeration of Philippine flowering plants, (in 4 vols.) 1922–26.
Praeger, R. L.
Aspects of plant life. 1921.
Snodgrass, R. E.
Anatomy and physiology of the honeybee. 1925.
Tolstoi, Count Leo
Anna Karenina, vol. 2. 1924.
U. S. Department of Agriculture
Fiber investigation report No. 9. 1897.
U. S. Department of Agriculture
Report on agricultural experiment station and cooperation. 1916.
U. S. Department of Agriculture
Yearbook. 1902, 1903, 1905, 1914.
U. S. Department of Agriculture. Botanical Division
Agricultural grasses and forage plants of the United States.
U. S. Department of Agriculture. Division of Publications
Circulars, Nos. 1–18, (1919–11)
U. S. Department of Agriculture, Division of Publications.
Index to farmers' bulletins Nos. 1–500.
U. S. Department of Agriculture. Division of Publications
Miscellaneous publications. 1914–17, 1918–20.
U. S. Department of Agriculture. Office of the Experiment Station
Annual reports, 1902–1912.
U. S. Department of Agriculture. Office of the Experiment Station
Bulletins, Nos. 2, 7–12, 15, 14–18, 21, 28–35, 36–45, 46–54, 55–62, 63–73, 74–79, 80, 81–86, 87–93, 104, 119, 133, 158, 240–245.
U. S. Department of Agriculture. Office of Experiment Station
Experiment station work, Nos. I–XX. 1897–1902.
U. S. Department of Agriculture. Office of the Secretary
Circulars. Nos. 108–151 (1918–20).
Wells, H. G.
The outline of history. (In 4 vols.) 1924.
Wright, P. G.
Sugar in relation to tariff. 1924.